TEXTILES PAPER LEATHER

AMERICAN DYESTUFF REPORTER

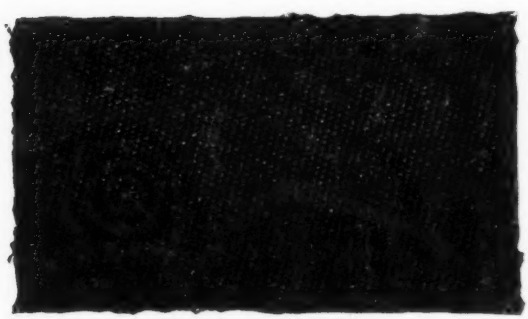
Including the Proceedings of the
AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XI NOVEMBER 20, 1922 NUMBER 11

GEIGY COMPANY, Inc.

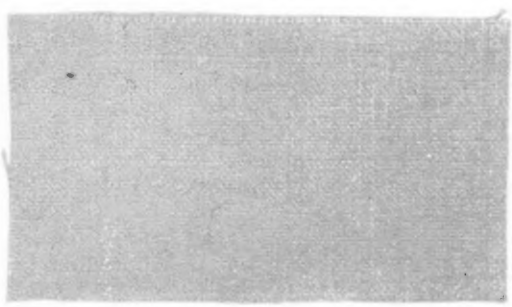
89-91 Barclay Street,
New York City

ANILINE COLORS



ERIO CHROME BROWN R

This is a level dyeing color with a good reputation. It is particularly well adapted to those materials requiring good fastness to light and fulling.



DIPHENYL BROWN G S CONC.

This is a level dyeing Direct Brown. Has particularly good fastness to Acid and storing. With Hydrosulphite it discharges a clear white. It receives our special recommendation for Union Dyeing.

Sole Selling Agents for J. R. GEIGY S. A., Basle, Switzerland
Established 1764

Main Office J. R. Geigy S. A., Basle, Switzerland; in Great Britain
The Geigy Colour Co., Ltd., 35-37 Dickinson St., Manchester

BOSTON PROVIDENCE PHILADELPHIA TORONTO COLUMBUS, GA.

IRON FILINGS
IRON DUST

FOR CHEMICAL PURPOSES

A concern located in New England, which is in a position to supply large quantities of the above materials, is anxious to get in touch with dyestuff or other manufacturers who use them in their processes. Dealers' inquiries will also be welcome. Screenings to special specifications can be made where volume of business warrants.

Please communicate with

American Dyestuff Reporter
4109 Woolworth Bldg. New York City

American Dyestuff Reporter, Vol. XI, No. 11. Nov. 20, 1922. Published biweekly by Howes Publishing Co., Woolworth Building, New York, N. Y. Domestic subscription, $5.00; Canadian, $5.50; foreign, $6.00. Entered as second-class matter Nov. 6, 1919, at the New York, N. Y., Post-office, under the Act of March 3, 1879. Copyrighted, 1922, by Howes Publishing Co.

MATHIESON Chemicals

Caustic Soda in Liquid Form

99% NaOH
GUARANTEED

MANY manufacturers are now using caustic soda in liquid form.

They have found that the use of liquid caustic effects a worth-while saving over the use of the solid material packed in drums. It reduces the cost of handling and dissolving.

Mathieson Liquid Caustic Soda — analyzing less than 0.50% of Sodium Carbonate, less than 0.20% of Sodium Chloride, less than 0.07% of Sodium Sulphate; permitting us to guarantee a minimum of 99.00% Sodium Hydroxide — is shipped in tank cars from Niagara Falls in a non-freezing solution averaging 25% of Solid Sodium Hydroxide, or about 32 degrees Baumé.

The use of Mathieson Liquid Caustic Soda assures you economical operation and uniform results, at the same cost.

MATHIESON ALKALI WORKS *INC.*
25 West 43rd. Street
NEW YORK CITY
PHILADELPHIA CHICAGO
PROVIDENCE CHARLOTTE

EAGLE THISTLE PRODUCTS

Deal Direct with the Manufacturer

"SILK BROWN G"

A new, level dyeing, fast acid color for Wool or Silk. Also an excellent neutral dyeing color. Dyes Silk or Wool in neutral or even in slightly alkaline bath.

Heretofore the shading of light colors on silk or wool in a neutral bath was usually accomplished with red and yellow, with results far from satisfactory.

"SILK BROWN G" brings relief to the union dyer as a mellow brown to shade greys and light fancy colors on silk or wool in union, as well as a ground color for Tan, etc. Is extremely level dyeing either when dyed in an acid bath or neutral bath.

"Silk Brown G"

Manufactured only by

ALTHOUSE CHEMICAL COMPANY, *Office and Plant: READING, PA.*

F. E. ATTEAUX & COMPANY, Inc.

172-178 Purchase Street, Boston

Sole Selling Agents for

Palatine Aniline & Chemical Corp.

Poughkeepsie, New York

New Product

Empire Coralline—for Wool and Silk

Brilliant color of exceptional fastness to light and milling.

F. E. ATTEAUX & COMPANY, Inc.

BOSTON NEW YORK PHILADELPHIA CHICAGO

ESSEX DYESTUFFS

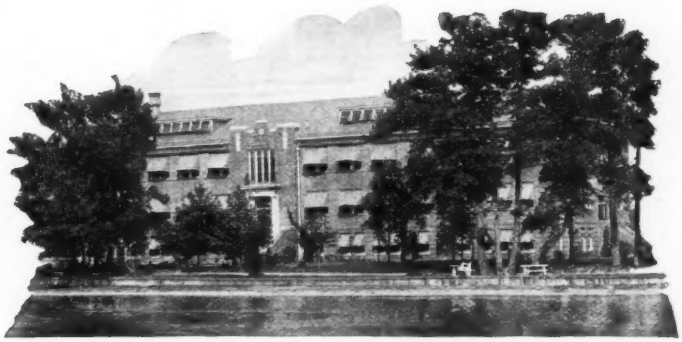
DIRECT YELLOW CF	DIRECT FAST BROWN M	DIRECT PINK SX
CHRYSOPHENINE CONC.	DIRECT ORANGE R	DIRECT FAST SCARLET B
DIRECT YELLOW 2G	DIRECT ORANGE 2RE	ERICA 2GN
DIRECT FAST YELLOW B	DIRECT ORANGE 5RE	DIRECT ROSE FFB
COTTON YELLOW 5G	DIRECT PINK NY	DIRECT ROSE NB
DIRECT BROWN 2R	DIRECT PINK 2Y	DIRECT GREEN 2B
DIRECT BROWN 2Y		CHROME GREEN B CONC.

ESSEX ANILINE WORKS, Inc.

Manufacturers of Aniline Colors.

88 Broad Street, Boston, Mass. Factory at South Middleton, Mass.

The Grasselli Chemical Co., Sole Sales Agents, 117 Hudson St., New York City



The Du Pont Dyestuffs Technical Laboratory, Deepwater, N. J.

Double Checked

From the time the crude dyestuff is dry, up to when it arrives at the shipping house, dye experts at the Technical Laboratory control the treatment of each pound of color received.

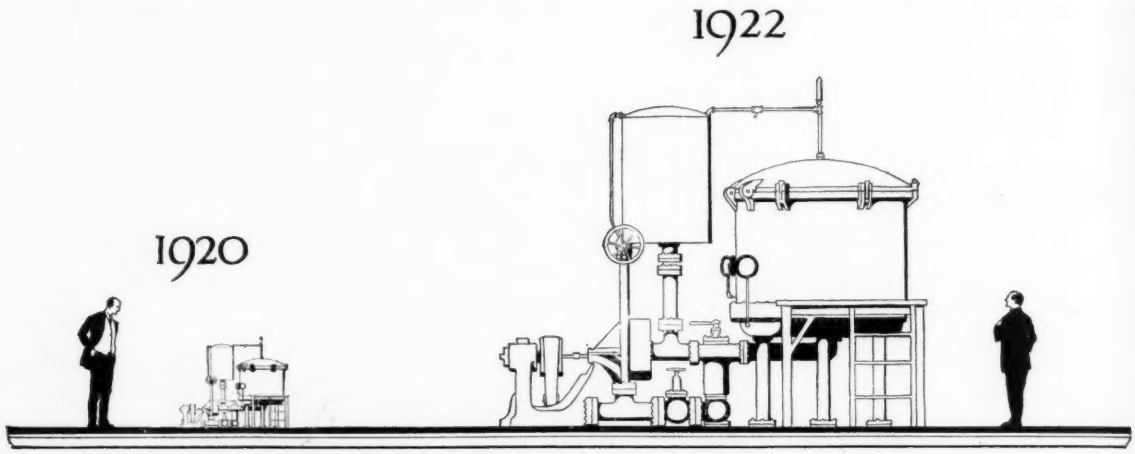
In each lot of dyestuff, shade, strength and solubility are kept constant by a double system of checking.

The dyeing qualities are always under the observation of a corps of technical demonstrators, among whom are specialists trained in each of the dye-consuming industries.

You can depend on uniform results from Du Pont Dyestuffs

E. I. du Pont de Nemours & Co., Inc.
Dyestuffs Department
WILMINGTON, DELAWARE
BRANCH OFFICES:
New York Boston Providence
Philadelphia Chicago
Charlotte, N. C.

STANDARD DU PONT DYESTUFFS UNIFORM



A Pigmy in 1920—A Giant in 1922

WHAT was a $25,000 or $50,000 annual saving to a dyer in 1920 when that amount was only a small fraction of his actual profits?

"Suppose I do save that much. I'm only saving it for the government." Perhaps nobody said that, but it was difficult to think any other way.

So in 1920 Franklin Package Dyeing Machines, although they could actually save $50,000 or more annually in many mills, were of pigmy importance to the average dyer.

But consider the situation in 1922. A $50,000 annual saving may mean the difference between an actual loss and a profit, and that is why the sales of Franklin Machines are growing rapidly.

Is YOUR business in the situation where additional economies are necessary in order to tip the scales from the LOSS side to the PROFIT side? If it is, you will be doubly interested in Franklin Package Dyeing Machines.

These machines dye yarn in the wound form under pressure using only one gallon of liquor to a pound of yarn. This short dye bath, combined with the fact that the kier is closed, effects savings of thousands of dollars in fuel and water in many cases.

Also because they dye in the wound form Franklin Machines eliminate the necessity of backwinding from warps or skeins, reducing winding costs from around 7 cents per pound to 2 cents per pound. Dyeing a million pounds a year the annual saving at this rate would be $50,000.

And there are other savings which we have not even mentioned, but which we will be glad to take up with you on request. Write for full particulars today, stating what kind of dyeing you wish to do. No obligations on your part.

FRANKLIN PROCESS CO.

Philadelphia PROVIDENCE Manchester, Eng.

New York Office, 72 Leonard Street

SOUTHERN FRANKLIN PROCESS CO.

Greenville, S. C.

SANDOZ

ANILINE DYES FOR ALL TRADES

SANDOZ

We carry a complete line at all Branches

For samples and prices apply at any of our offices

SANDOZ CHEMICAL WORKS
INCORPORATED

238-240 Water St. NEW YORK
12 So. Front St. PHILADELPHIA
36 Purchase St. BOSTON
175 Market St. PATERSON
Commercial Bank Bldg. CHARLOTTE, N. C.

THE EMBARGO DIED HARD

—BUT as a result protection to the American Industry is assured by rates giving more than adequate protection, and the consumer can get what he wants without dictation as to what he shall use.

The following dyestuffs

INDANTHRENE
THIO-INDIGO
HELINDONE
HYDRONE
ALGOL

will be imported by us direct from the manufacturers—

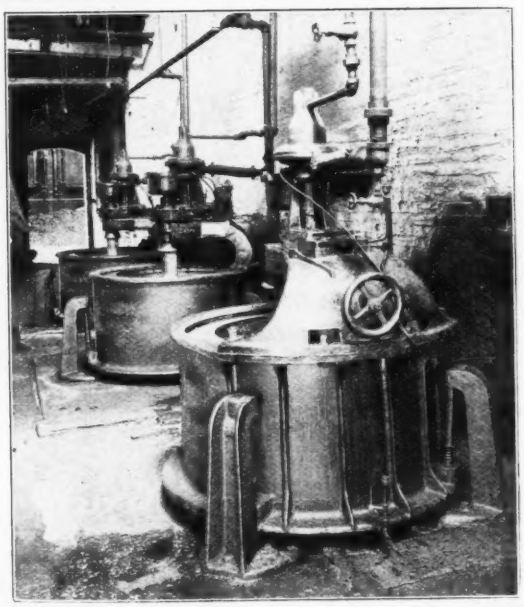
FARBWERKE VORM. MEISTER, LUCIUS & BRÜNING
FARBENFABRIKEN VORM. FRIED. BAYER & CO.
CHEMISCHE FABRIK GRIESHEIM-ELECTRON
BERLIN-ACTIEN GESELLSCHAFT FÜR ANILIN-FABRIKATION
LEOPOLD CASSELLA & CO.
FARBWERKE-MÜHLHEIM
KALLE & CO.

Dyestuffs manufactured by

CONSOLIDATED COLOR & CHEMICAL CO.
CENTRAL DYESTUFF & CHEMICAL CO.
WILLIAMSBURG CHEMICAL CO.

and other American manufacturers distributed by

H. A. METZ & CO. Inc.
One-Twenty-Two Hudson Street New York City.
Boston Philadelphia Providence Chicago Charlotte San Francisco



FLETCHER

STEAM TURBINE DRIVEN

EXTRACTORS

are more than making good under the severest conditions. Increased output at less cost is inevitable where these machines are installed.

Other dependable types are belt-driven, vertical motor-driven and electric underdriven.

FLETCHER WORKS

INCORPORATED
Formerly Schaum & Uhlinger
Established 1850

GLENWOOD AVENUE, AT SECOND STREET, PHILADELPHIA, U. S. A.

New England Representatives: HURRICANE ENGINEERING COMPANY, 53 STATE STREET, BOSTON, MASS.
Western Representatives: R. R. STREET & CO., 28 N. CLINTON STREET, CHICAGO, ILL.
Southern Representative: H. MORSHEAD, GLENWOOD AVENUE and SECOND STREET, PHILADELPHIA, PA.

ISO-CHROME COLORS

These products are proving of exceptional interest on account of their simplicity of dyeing by the one-bath method; their fullness of shade; fastness; and level dyeing qualities.

JENNINGS & COMPANY

INCORPORATED

93 Broad Street, **Boston, Mass.**

SOLD OUT

——WHITTAKER'S BOOK——

"The Testing of Dyestuffs in the Laboratory"

THE sixth importation of this newest and most popular work by Mr. Whittaker is rapidly becoming exhausted owing to the continued demand. We can supply, however, a limited number to those who will act promptly.

"The Testing of Dyestuffs in the Laboratory" presents in condensed form the results of over twenty years' practical experience. It deals in general with the dyestuff testing laboratory and its functions and in particular with methods for the testing and evaluation of the different types of dyestuff, including the natural colors. Every dye chemist should order his copy NOW to insure early delivery.

PRICE $4.50, POSTAGE PAID

HOWES PUBLISHING COMPANY

4109 Woolworth Building NEW YORK CITY

DYESTUFF IMPORTATION

The removal of the Dyestuff Embargo has created an entirely new condition which we must face.

Having in mind the interests of the Dyestuff Consuming Industries who require **foreign-made colors** as well as those made by **American Dyestuff Manufacturers,** we have organized an **Import Department** and are now in a position to supply such products.

Being thoroughly familiar with the foreign range of Dyestuffs, past and present, we solicit inquiries.

As MANUFACTURERS and IMPORTERS we are ready and able to meet the most exacting requirements of Dyestuff Consumers.

Samples and Prices Cheerfully Furnished

JOHN CAMPBELL & COMPANY

75 Hudson Street ESTABLISHED 1876 **New York, N. Y.**

Branches:

Boston **Providence** **Chicago** **Philadelphia** **San Francisco** **Toronto**

N. T. Y.

INDOPHENAL BLUE

ALL SHADES

FROM SKY BLUE TO BRILLIANT REDDISH TYPE

These products are especially adapted to all kinds of dyeing where a better grade of Sulphur Color is required

They are distinguished by their excellent solubility, fastness to light, washing, rubbing, alkali and acid.

MADE BY

TOWER MANUFACTURING CO., Inc.

DYESTUFFS DEPARTMENT

SALES OFFICE AND FACTORY

85 to 105 DOREMUS AVENUE **NEWARK, NEW JERSEY**

Anthranol Chrome Blue Black AR

Dyes chrome mordant or top chromed. Recommended for fast shades of navy blue or all classes of stock. On account of its shade, level dyeing properties and solubility it is especially suitable for piece dyeing

Anthranol Chrome Brown W

Dyes chrome mordant or top chromed. Is fast to light and fulling. The most level dyeing brown on the market.

Acid Chrome Blue F 4 B

Similar to the pre-war Chromotrope F4B. Of special interest for dyeing piece goods to leave silk white.

United States Color & Chemical Company, Inc.

93 Broad St. Boston, Mass.

New York Office: 25 Howard St.

FACTORIES:
NEW ENGLAND ANILINE WORKS, Inc.
Ashland, Mass.

GARFIELD ANILINE WORKS, Inc.
Garfield, N. J.

I. LEVINSTEIN & CO.
INCORPORATED

281-5 Franklin Street
Boston, Mass.

offer a
full line of
American made
and
British made

DYESTUFFS

They represent
British Dyestuffs Corporation, Ltd.
Manchester, England
They are introducing to this country

DUROPRENE — *An acid and alkali proof varnish*
VELVONA — *A new inert base and filler*

Established 1895

BOSSON & LANE

Manufacturers of

The Original
BLEACHING OIL
for boiling out Cotton, to produce a foundation for a Pure White

High Grade Sulphonated and Saponified
CASTOR OIL PRODUCTS

Para Soap Oil

Solvents and Assistants for cleaning all Textiles

B & L Bleachers' Bluings and Tints

Works and Office, ATLANTIC, MASS.

Contents of This Issue

November 20, 1922

The Practical Dyeing of Cotton Piece Goods 369
M. W. Alling and C. L. Brainerd

American-Made Colors: Group IV—Direct Colors 373

Multi-Color Effects in Simple Piece Dyeing 377

Proceedings of the American Association of Textile Chemists and Colorists:
Tenth Council Meeting..... 379
Program of Second Annual Meeting... 380
Proposed Amendments to the Constitution 380
Organization Meeting of Philadelphia Section 381
A Summary of the Progress Made to Date by Various Investigators in an Effort to Standardize Methods for Determining the Fastness of Dyes to Light 382
The Testing of Dyes and Their Fastness to Light Under the Quartz Mercury Arc Lamp. A Paper by S. W. Robinson 384

Editorial.
The Wrong Road to Harmony..... 387

Mordants (In three parts—Part III).... 391
Wilder D. Bancroft

Dyeing Wool-Silk Materials the Same Shade 399
George Emmons

Mechanical Appliances for Pumping Chemical Solutions (In three parts—Part III) 401
A. K. Fischer

Bleachers!

"Better fabrics" is the cry. You want to start by giving them a Better Bleach.

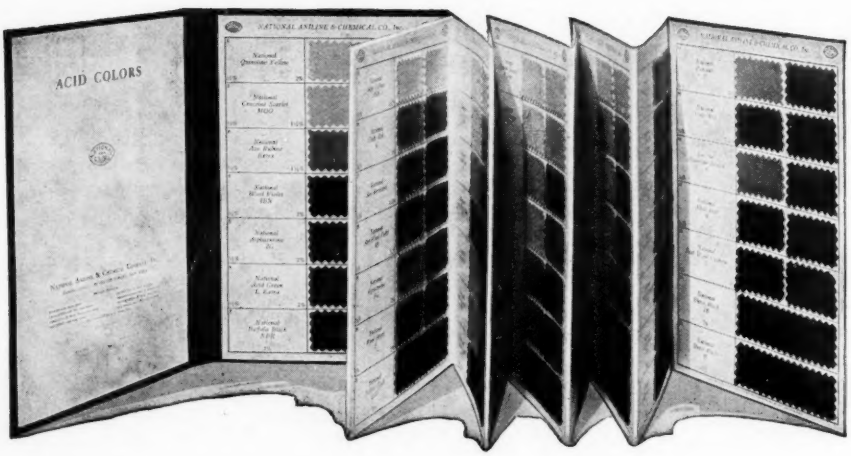
The goods should be given a permanent white without weakening, of greatest elasticity and softness.

Only Peroxide bleaching can do all this, without increase in cost.

Ask us how.

THE ROESSLER & HASSLACHER CHEMICAL CO.
New York

NATIONAL U.S.A. DYES



69 *"National" Dyes are shown in the New Acid Color Shade Card*

THE development of new types of Acid Colors by the "National" has made necessary a revision of the Acid Color Shade Card.

The new edition contains dyeings of sixty-nine (69) colors on woolen piece goods, each color dyed in at least two strengths. Practically any desired shade can be produced by a combination of the sixty-nine colors listed.

Acid Colors constitute the most important group of dyes for woolen and worsted materials. They also find extensive use in the dyeing of silk, leather, paper, in shoe polishes, and in many other trades.

We have therefore included in this shade card the leading characteristics of each dye, and the uses for which it is best suited.

This new color card will be found a valuable addition to the working library of the practical dyer as well as the mill executive. Copies may be secured from any of the Company's branch offices.

National Aniline and Chemical Company, Inc.

New York *Chicago* *Charlotte* *Toronto* *Philadelphia*
Boston *Hartford* *Montreal* *Providence* *San Francisco*

AMERICAN DYESTUFF REPORTER

"Circulated Everywhere Dyestuffs Are Used"

Devoted to the practical application of dyestuffs in all industries; especially to textile chemistry—the science and practice of scouring, bleaching, dyeing and finishing.

VOLUME XI | NEW YORK, NOVEMBER 20, 1922 | NUMBER 11

The Practical Dyeing of Cotton Piece Goods

Importance of Time in Large Works—Obtaining the Correct Shade—Varieties of Machinery Necessary—Jigs and Padders—The Slop Padder—Jig Dyeing—Direct and Basic Colors for Use in Jig—Mordanting—Miscellaneous Methods—Continuous Dyeing

By M. W. ALLING and C. L. BRAINERD

Waldrich Bleachery, Delawanna, N. J.

Maintenance of Production Essential

THE outlook for a dyer of cotton piece goods as he steps into his office Monday morning is greatly affected by whether he has planned and executed a part of his work during the previous week.

In a large dyehouse—that is, one where there is machinery and men to dye upwards of one hundred and eighty thousand yards of cloth per day—time is the big element to utilize in machine production. By machine production is meant the number of yards of cloth that actually pass through the dyeing machines in a given time. To make the most of this machine production requires careful planning and a positive schedule which must be followed very closely. The dye formulae have to be made out in advance; these in turn are weighed out and dissolved in the drug room. While this is being done, the machine operators are putting their machines into condition and getting their cloth ready to dye.

Importance of Complete Solution of Dye

As fast as the dye solutions are ready, an experienced man mixes them in the tanks which feed the machines. Careful attention has to be given to the straining and boiling so as to prevent small particles of undissolved color spotting the goods. The dissolving of the dye should always be preceded by a necessary softening of the water, if the plant is not equipped with a water-softening apparatus. As a final precaution, it has been found to be very practical to cover the outlet pipe that runs into the dye trough with a suitable cloth to make the results foolproof.

The skill of the dyer is put to the test as soon as the machine operators present their patches for shading to their respective samples. Good judgment in using the right dyes and amounts in shading is a big time saver. In some cases where the same shade is repeatedly ordered it is possible to use the same formula over and over again. Where this is done, it is just a case of running a patch in this solution and checking the result with a patch from the previous lot or the standard given. On the other hand, where a special sample with a new formula has to be matched, it is often necessary to make additions or alterations in the dye solution until the correct shade is produced. The dyer has a wonderful opportunity to bring into play the power of system and of keeping formula records for this type of work.

Obtaining Correct Shade

There are two ways to obtain the correct shade before going ahead with the dyeing operation on a padding machine. One way is to fill the trough underneath the pad rolls with the dye solution, as mixed in the stock tanks, using the proper amount of water so as to show the true depth, and then running through this a patch 1 yard long and 3 inches wide, drying it up and comparing the result with the sample to be matched. The other way is by using a small patch box to run the patch through instead of the large box. The large box takes about 30 gallons of the dye solution, whereas the patch box takes 1 gallon of the dye liquod and ¼ gallon of water. This latter method is very convenient, in that it saves a lot of time and dyestuffs and gives practically the same result.

There are two tanks holding the stock solutions for feeding a padding machine trough, and each should hold at least 300 gallons. This combined amount is used up in two machine production hours. They are piped up so that they can both be used as one tank or separately. Two different formulae can be made up in the two tanks, and by using a double-compartment patch box both shades can be struck off at one time, so that whichever one is the correct shade can be run first and the other is well on its way toward being correct.

Necessary Machinery

In a dyehouse with a capacity of production as previously stated there is bound to be a very large variety of cloth to be handled as well as innumerable shades to be matched. These require various processes and different kinds of machinery. The processes are dependent upon the use to which the cloth is to be put. If the customer orders a fast Navy Blue shade to be used in making raincapes, it would be very unwise to use any process of dyeing other than one to produce a shade which would not make one blue in the face during a rainstorm.

The machinery for dyeing cotton piece goods is of two distinct kinds. The one is used for dyeing light shades, and is called a padding machine; the other type, for dyeing dark shades, is called a jig.

The padding machine is built on the principle of a wringer, with a trough underneath in which the dye solution is fed from large tanks overhead. The bottom roll rests in the dye solution and as it revolves with the cloth passing through it the dye solution is carried up to the cloth, wetting it out evenly with the colored solution. Upon subsequent drying the water evaporates, leaving a perfectly dyed piece of goods. This type is known as a slop padder. Machines for this kind of work are in use which dye the cloth at a speed of 216 yards per minute. If the machine production is carried on for five hours out of a ten-hour working day the enormous amount of 64,800 yards is dyed on one machine. In a dyehouse it is necessary to have three of these padding machines. Conditions are not always favorable enough to allow these three machines to produce a machine production of five hours each in any one day.

Three other padding machines, with drying cans attached, are needed. These cans, or cylinders, are made of either tin or copper, are filled with steam, and revolve with the cloth. The cans, as a rule, are set up in stacks. Thirty of these cylinders with a steam pressure of 10 pounds will dry the average kind of cloth at a speed of 60 yards per minute. The principle of the padding machine placed in front of these cans is the same as the other faster pad. In both cases the cloth is impregnated with the dye solution in the same manner. When dyeing very heavy cloth more even results are obtained by dipping the cloth underneath the liquor, in addition to its contact with the liquor on the roll.

Cotton cloth has a natural affinity for direct dyes; that is, it absorbs the dyestuff which is carried through on the cloth, as well as some of the dyestuff which is in the solution squeezed back by the padding rolls. This latter, of course, gradually weakens the dye liquor and the cloth does not keep the same depth of shade that it started with. This difficulty is taken care of by starting the operation with a weakened dye solution; by adding the proper amount of water in the trough underneath the squeeze rolls. By careful practice this unevenness can be reduced to a minimum.

Jig Dyeing

The dark shades are generally dyed on the jig. The jig is composed of a wooden trough with sloping sides, having a capacity of about 100 gallons. There are four rolls set in this, two in the corners near the bottom and the other two at the top near the sides. There is an outlet pipe in the bottom and a perforated steam pipe the whole length, so that the live steam is blown directly into the dye solution. Above this trough are two rubber beams which are geared to a shaft, with a clutch on the shaft in between the beams, so that when one of the beams is thrown into gear it revolves outwardly and when the shifting lever is thrown over the other way this beam stops and the other beam turns outwardly. A brake is provided on the end of each beam to keep the cloth at a uniform tension as it passes from one beam down through the liquor and up on to the other beam.

Cotton piece goods dyed on the jig are wound on from a roll of a convenient size to handle, not usually more than 800 yards, depending upon the weight and bulk of the cloth. The method of putting the cloth on the jig preparatory to dyeing is first to place a roll of cloth in the upright arms of the ends of a beam, taking the end of the cloth and threading it under the four rolls in the dye trough and wrapping it around the beam on the other side. It is then run onto this beam by throwing in the clutch, which turns the beam until the cloth is all wound on with the exception of the last end, this being left wrapped around its beam. The cloth is now ready to run back and forth at will.

In most dyehouses one man runs two jigs. However, this depends upon the make of the clutches. If a clutch grips and releases itself freely from the connecting shaft it is possible for one man to run six jigs very easily; but where a cone clutch is used, and the only way to separate them is by giving them a blow with a piece of shafting or some other kind of a hammer, he can only take care of two.

It is important, after the dyeing operation has been started, to stop the roll so that the end does not go all the way through and unthread the machine. If this

happens the end must be pulled back through the hot liquor by means of a large hook.

The rolls of cloth are either wet out or dry when they come to the jigs; in either case they are run through cold water before dyeing, so as to make them uniformly wet and absorbent throughout.

There are two common types of dyestuffs in use for jig dyeing. They are the direct colors and basic colors. The cotton has a natural affinity for the direct dyes, but not so for the basic dyes. In the use of the latter a chemical or indirect method has to be resorted to in order to attract and hold the dye on the fiber. This process is known as mordanting the cloth.

Mordanting for Basic Dyes

In the mordanting process the cloth is first saturated with tannic acid either on the padding machine or on the jigs. The padding machine gives the best results, but it is necessary to run the cloth perfectly straight and to batch or roll it up as fast as it passes through the liquor, otherwise if the edges are exposed the tannic acid is chilled and is very likely to dry out and cause the cloth to have discolored edges or selvedges when dyed. The strength of tannic acid for dyeing Purples, Royal Blues, Emerald Greens and American Beauties is from 1½ to 2 ounces per gallons at about 150 deg. Fahr. After running the proper size rolls through this solution they are placed on the jigs and run through a cold solution of antimony salt or tartar emetic. This combination precipitates the insoluble antimony tannate evenly through the cotton fiber. The compound has a great affinity for the basic dyestuffs, which are applied in a cold acetic acid bath.

The jig trough is partly filled with the requisite amount of water and one-half of the previously dissolved dye is put into this water and stirred up with a stick until the solution is uniform. The cloth is then set in motion and is run through to the end; then the other half of the dye is added, stirred and the cloth is run again; after these two runs, or ends as they are called, a third end is run to insure an even shade from end to end, and in the middle of the batch a patch 6 inches long and 3 inches wide is taken out at a seam, which are usually in multiples 60 yards apart. This is dried and the dyer compares it with the sample to be matched. It is not unusual that the correct shade is obtained at this point, so that the cloth is rolled up on a separate roll which rests upon the beam. It is then mangled and dried.

To obtain shades of Slate, Brown, Khaki, Red, Green, Yellow, Navy Blue and Cadet Blue, in all their various depths and tones, the direct dyes are used. The cloth is run back and forth through a boiling-hot solution of one, or a mixture of these dyes, for three ends, at which time the cloth has not had long enough contact with the dye liquor to be colored the full shade, so that an addition of salt in each of two more ends is made. This tends to throw the dyes out of the solution onto the cloth. If enough salt is added to the dye bath the dyestuff will be precipitated, but ordinary care will prevent this.

A great many dyestuffs of different shade and quality are manufactured, and it is necessary at all times to keep a sufficient variety on hand to produce any shade that may be called for by a customer. The customer provides all samples to be matched. The dyer should keep a loose-leaf book filled with formulae and a patch of the shade that each formula produces. He compares the sample to be matched with the nearest formula and shade which he has on record. If in the subsequent dyeing procedure the tone is not just right, additions of the correct dyes are made until the match is perfect. The cloth is then taken off and another shade or the same shade is put on to be dyed on fresh cloth in the same manner.

A very good average production for a jig operator in a day of ten hours, for each jig, is 2,000 yards. The average large dyehouse needs thirty or forty of these jigs to take care of this class of work.

Miscellaneous Methods

There are numerous other dyeing machines and processes for dyeing Turkey Red, Sulphur Khaki, Logwood Black, Aniline Black, Sulphur Navy, Sulphur Cadet, Developed Colors and Fast Red. These are in a class by themselves, in that they are practically fast to washing, whereas those previously mentioned will not stand boiling with white cloth on account of bleeding.

The so-called "sun-fast dyes" are in some cases certain direct dyestuffs which have been dyed on the cloth and then after-treated with copper sulphate. This method gives a reasonably satisfactory result. Another method which gives the fastest known shades is the vat dyeing process. These dyes, in the first place, are insoluble in water, but with the addition of hydrosulphite become reduced and are soluble in an alkaline solution of caustic soda, which is usually added with the hydrosulphite. When the cotton cloth is passed through this reduced solution and subsequently reoxidized, a dyeing of great fastness to light and washing is produced.

Continuous Dyeing

Cloth dyed with sulphur dyes into a Khaki shade has been extensively used in making shirts and suits. The dyeing operation is done on a so-called continuous machine, which is simply a padding machine with several wash boxes attached to it. The dye is first dissolved in the smallest amount of water needed, together with the proper amount of sulphide, drawn off and strained into pails, and then added to the feeding tanks which are connected to the padder. This method

prevents any foreign matter from getting into the feed pipes on the machine.

The preparation of the cloth for sulphur dyeing of this type is very simple. The pieces of gray cloth are taken from the bale in the gray room, laid out on a flat truck, and the tar number put on and pieces sewed together. It is then singed over a gas flame and treated in a solution of diastafor in the same operation. This converts the starch in the gray goods to sugar and soluble starch, and these when washed thoroughly are entirely removed. This is sufficient treatment for light-weight goods, but goods weighing more than 4 yards to the pound should be given a second run in diastafor before washing. This insures the best possible method for cleaning the grays.

After the washing and drying, the goods are run through the dyeing machine at a rate of 50 to 60 yards a minute. For the particular grade mentioned a three-bowl padder, giving the cloth two dips in the liquor, is very satisfactory. After leaving the squeeze rolls the cloth passes over a series of wooden rollers through the air, which oxidizes the sulphur dye. It then passes through several wash boxes to wash off any surplus color and sodium sulphide. Care must be taken that this water runs to waste as fast as it is sprayed on the cloth, otherwise the sodium sulphide would wash out of the cloth in sufficient quantity to charge the water enough to cause a stripping action on the cloth. After passing through three wash boxes, the cloth is entered into a solution of chrome, bluestone and acetic acid, which fastens the dye and makes a perceptible change in the tone. The oxidation bath is also connected to feeding tanks and should always be on the acid side. The preceding wash boxes do not remove all of the sodium sulphide from the goods, and if the oxidation bath is not strongly acidulated a black precipitate of copper sulphide will stain the cloth. A thorough washing after the chrome bath is also essential, as any chrome left in the goods will appear as yellow stains upon drying.

The method for getting the right shade is by bringing into use a patch box set on front of an ordinary wringer. Patches struck off in this manner are very satisfactory, and a 60-yard piece can be run on the strength of the result. In fact, after a little experience it is not necessary to stop the machine at the end of 60 yards. Patches must be taken out every twelve hundred yards to see that the depth of shade stays constant. This can be regulated by evaporation, using a closed coil at the bottom of the feed tank, and when too much evaporation takes place, causing the depth to be a little strong, the steam is shut off. In order to control the tone desired a dyer must make a study of the exhaustive power of the dyestuffs he is using. Close observation of the first few pieces dyed will enable him to classify them according to their rate of exhaustion, and allowance can easily be made for this when starting a shade. Since the cloth does not take up the dye and moisture in the same proportion, the dyeing operation is always started with the proper amount of water in the pad trough. A little practice will enable one to make the first hundred years an exact match to the last hundred on a 10,000-yard run.

Two feeding tanks are necessary on a continuous machine to secure maximum production, as one tank can be run off while the other is being filled and the necessary shade obtained by means of the patch box and wringer. An addition of 1 quart of soluble oil and 1 quart of pine oil to every 45 gallons of liquor insures perfect penetration of the dye and eliminates streaks and stains due to uneven absorption of the dye.

Space will not permit of further descriptions of the subjects not already mentioned, but the most common dyeing methods have been covered and the authors trust they will be of interest to those who have knowledge of or who are interested in subjects of this kind.

INDIGO RESISTS FOR DYEING ON CONTINUOUS MACHINE

Pad the kier-boiled and dried cloth on a three-roll machine with a 7 deg. Be. glucose solution containing 1 per cent of starch; dry and calender.

Print on the resist paste, dry, slop pad with a pin roller an alkaline indigo print color of desired strength, dry carefully in hot air, steam twenty seconds in indigo ager with saturated steam, then run through continuous indigo vat machine two to four times, according to depth of shade desired; let the goods lie a short time, then sour, wash and dry.

White Resist.—Ten kilos verdigris 1/1, 5 kilos copper sulphate dissolved in 1 kilo water, 7.5 kilos China clay mixed with 4 kilos water, 25 kilos lead sulphate, 7 kilos British gum, 20 kilos gum solution 1/1, 16 kilos lead nitrate, 10 kilos lead acetate, 1 kilo copper nitrate.

Yellow, Orange or Cream.—Forty kilos lead acetate, 20 kilos litharge, 60 kilos water, 56 kilos lead nitrate, 40 kilos copper sulphate, 112 kilos lead sulphate, 40 kilos British gum, 15 kilos dextrine, 1.5 kilos talc, 1.5 kilos beeswax, 4 kilos turpentine.

If other colored resists are to be printed, such as light blue, green or olive, the goods are dyed light blue before padding with glucose.

For green and olive print a lead resist, for light blue a resist without lead.

The indigo pad color is made as follows: 10.5 kilos cornstarch, 21 kilos British gum, 26 kilos water, 250 kilos caustic soda 38 deg. Be., 34 kilos indigo 20 per cent paste, 39 kilos caustic soda 39 deg. Be. Heat to 65 to 70 deg. Cent. Then cool as rapidly as possible.—Textilberichte, through Dyer and Calico Printer.

M. W. Dippel, president of the National Ribbon Co. for the past 21 years, has announced his intention to retire from business on January 2, 1923. A. Muller will carry on the business.

American-Made Colors

A Classified List of All Dyes of American Manufacture, Giving the Name of the Maker and His Trade Name for Each Product

Group IV.—Direct Colors

Including Developed Colors

BLACK

Newport Neutral Grey G
Newport Chemical Works, Inc.

Newport Fast Silk Grey M Conc.
Newport Chemical Works, Inc.

Newport Artificial Silk Black SBR
Newport Chemical Works, Inc.

Newport Direct Black 2G
Newport Chemical Works, Inc.

Newport Direct Black RW
Newport Chemical Works, Inc.

Newport Direct Black RB Extra
Newport Chemical Works, Inc.

Newport Direct Black EG Extra
Newport Chemical Works, Inc.

Newport Direct Black EE Extra Conc.
Newport Chemical Works, Inc.

Newport Diazo Black RS
Newport Chemical Works, Inc.

Newport Diazo Black BH Extra Conc.
Newport Chemical Works, Inc.

Newport Developed Black 2BN
Newport Chemical Works, Inc.

Newport Developed Black SC
Newport Chemical Works, Inc.

Newport Developed Black BH Ex. Conc.
Newport Chemical Works, Inc.

Newport Developed Black S Extra Conc.
Newport Chemical Works, Inc.

Newport Fast Black V
Newport Chemical Works, Inc.

Direct Black GX
Monroe Color & Chemical Co.

Direct Fast Black HW
Peerless Color Co., Inc.

Amanil Black GL Ex.
American Aniline Products, Inc.

Amanil Black ROL
American Aniline Products, Inc.

Amanil Black BH Conc.
American Aniline Products, Inc.

Amanil Black BOL
American Aniline Products, Inc.

Amidine Black BH
John Campbell & Co.

Amidine Black MH Conc.
John Campbell & Co.

Amidine Black RB Conc.
John Campbell & Co.

Amidine Fast Black L
John Campbell & Co.

Pluto Black CF Extra
John Campbell & Co.

Pluto Black 3B Extra
John Campbell & Co.

National Diazine Black V
National Aniline & Chemical Co.

National Diazine Black DR
National Aniline & Chemical Co.

National Diazine Beta Black N
National Aniline & Chemical Co.

National Erie Fast Gray R
National Aniline & Chemical Co.

National Erie Fast Gray M
National Aniline & Chemical Co.

National Erie Black NR Extra
National Aniline & Chemical Co.

National Erie Black RXOO
National Aniline & Chemical Co.

National Erie Black GXOO
National Aniline & Chemical Co.

National Diazine Black H Extra
National Aniline & Chemical Co.

Zambesi Black V
Cincinnati Chemical Works

Direct Fast Black FF
Cincinnati Chemical Works

Direct Fast Black FB
Cincinnati Chemical Works

Direct Black E
Cincinnati Chemical Works

Diazo Black BH
Butterworth-Judson Corporation

Diazo Black BH Ex.
Butterworth-Judson Corporation

Pontamine Diazo Black BH Conc.
E. I. du Pont de Nemours & Co.

Pontamine Fast Black FF
E. I. du Pont de Nemours & Co.

Pontamine Black EX
E. I. du Pont de Nemours & Co.

Pontamine Black RX
E. I. du Pont de Nemours & Co.

Pontamine Fast Black L
E. I. du Pont de Nemours & Co.

Erie Direct Black RX
Croton Color & Chemical Co.

Direct Deep Black EW
Croton Color & Chemical Co.

Direct Black RXX
Noil Chemical & Color Works, Inc.

Direct Black RE
Noil Chemical & Color Works, Inc.

Direct Black GXX
Noil Chemical & Color Works, Inc.

Direct Black E
Noil Chemical & Color Works, Inc.

Central Black BH
Central Dyestuff & Chemical Co.

Pacco Direct Black E Extra
Palatine Aniline & Chemical Corp.

Atlantamine Black E
Atlantic Dyestuff Co.

BLUE

Atlantamine Blue 2BN
Atlantic Dyestuff Co.

Benzo Blue BB
Monroe Color & Chemical Co.

Direct Blue 2B
Butterworth-Judson Corporation

Newport Direct Blue 2BG
Newport Chemical Works, Inc.

Newport Direct Blue BXG
Newport Chemical Works, Inc.

Newport Direct Blue 2B Conc.
Newport Chemical Works, Inc.

Newport Direct Blue 3B
Newport Chemical Works, Inc.

Newport Direct Blue BX
Newport Chemical Works, Inc.

Newport Direct Blue 3R
Newport Chemical Works, Inc.

Newport Direct Blue BR Conc.
Newport Chemical Works, Inc.

Newport Direct Sky Blue
Newport Chemical Works, Inc.

Newport Direct Sky Blue FF
Newport Chemical Works, Inc.

Newport Direct Sky Blue 6B Conc.
Newport Chemical Works, Inc.

Newport Direct Sky Blue 10B
Newport Chemical Works, Inc.

Newport Direct Sky Blue 5BF
Newport Chemical Works, Inc.

Newport Direct Brilliant Blue G
Newport Chemical Works, Inc.

Newport Direct Steel Blue G Conc.
Newport Chemical Works, Inc.

Newport Cadet Blue
Newport Chemical Works, Inc.

Newport Direct Fast Blue RW
Newport Chemical Works, Inc.

Newport Direct Fast Blue SFF
Newport Chemical Works, Inc.

Newport Direct Fast Blue 2GL
Newport Chemical Works, Inc.

Newport Benzo Azurine G Extra
Newport Chemical Works, Inc.

Newport Benzo Azurine BD Conc.
Newport Chemical Works, Inc.

Direct Brilliant Blue GR
Peerless Color Co., Inc.

Amanil Blue BB
American Aniline Products, Inc.

Amidine Blue 2B
John Campbell & Co.

Amidine Blue 4B Conc.
John Campbell & Co.

Amidine Sky Blue 5BN
John Campbell & Co.

National Niagara Sky Blue
National Aniline & Chemical Co.

National Niagara Sky Blue 6B
National Aniline & Chemical Co.

National Niagara Blue 2B
National Aniline & Chemical Co.

National Niagara Blue 3B
National Aniline & Chemical Co.

National Niagara Blue G Conc.
National Aniline & Chemical Co.

National Niagara Blue 3RD
National Aniline & Chemical Co.

National Niagara Blue NR
National Aniline & Chemical Co.

National Niagara Blue DB
National Aniline & Chemical Co.

National Niagara Blue R
National Aniline & Chemical Co.

National Niagara Blue HW
National Aniline & Chemical Co.

National Niagara Blue RW
National Aniline & Chemical Co.

National Niagara Blue BR
National Aniline & Chemical Co.

National Niagara Fast Blue RL
National Aniline & Chemical Co.

Direct New Fast Blue
Althouse Chemical Co.

Blue 2B
Althouse Chemical Co.

Direct Blue 2B
Noil Chemical & Color Works, Inc.

Direct Blue 2BX
Noil Chemical & Color Works, Inc.

Pontamine Copper Blue RRX
E. I. du Pont de Nemours & Co.

Pontamine Sky Blue 5BX
E. I. du Pont de Nemours & Co.

Pontamine Sky Blue 5BX Conc.
E. I. du Pont de Nemours & Co.

Pontamine Sky Blue 6BX
E. I. du Pont de Nemours & Co.

Pontamine Blue AX
E. I. du Pont de Nemours & Co.

Pontamine Blue BBF
E. I. du Pont de Nemours & Co.

Direct Blue 2B
Cincinnati Chemical Works

Direct Blue 3B
Cincinnati Chemical Works

Direct Blue BX
Cincinnati Chemical Works

Diamine Blue 2B
Central Dyestuff & Chemical Co.

Diamine Blue 3B
Central Dyestuff & Chemical Co.

BROWN

Centraline Brown M
Central Dyestuff & Chemical Co.

Centraline Brown 3G
Central Dyestuff & Chemical Co.

Cotton Brown G
Central Dyestuff & Chemical Co.

Atlantamine Cordovan
Atlantic Dyestuff Co.

Atlantamine Brown 2G
Atlantic Dyestuff Co.

Direct Fast Brown G
Peerless Color Co., Inc.

Direct Fast Brown 5R
Peerless Color Co., Inc.

Direct Fast Brown RG
Peerless Color Co., Inc.

Direct Brown M
Butterworth-Judson Corporation

Direct Brown T
Cincinnati Chemical Works

Benzo Brown GR
Grasselli Chemical Co.

Benzo Brown D3G
Grasselli Chemical Co.

Newport Direct Brown GXR
Newport Chemical Works, Inc.

Newport Direct Brown RB
Newport Chemical Works, Inc.

Newport Direct Brown RXN
Newport Chemical Works, Inc.

Newport Direct Brown GN
Newport Chemical Works, Inc.

Newport Direct Brown CR
Newport Chemical Works, Inc.

Newport Direct Brown VM
Newport Chemical Works, Inc.

Newport Direct Fast Brown M
Newport Chemical Works, Inc.

Newport Direct Fast Brown MB
Newport Chemical Works, Inc.

Essex Direct Fast Brown M
Essex Aniline Works, Inc.

Essex Direct Brown D3GA
Essex Aniline Works, Inc.

Essex Direct Brown 2Y
Essex Aniline Works, Inc.

Essex Direct Brown 2R
Essex Aniline Works, Inc.

Amidine Brown M
John Campbell & Co.

Amidine Fast Brown 3R
John Campbell & Co.

Amidine Brown XY
John Campbell & Co.

Amidine Brown GG
John Campbell & Co.

Pontamine Brown D3G
E. I. du Pont de Nemours & Co.

Pontamine Brown R
E. I. du Pont de Nemours & Co.

Pontamine Brown CG
E. I. du Pont de Nemours & Co.

Pacco Direct Brown M
Palatine Aniline & Chemical Corp.

Pacco Direct Brown C
Palatine Aniline & Chemical Corp.

Diazo Seal Brown
Althouse Chemical Co.

Benzanol Brown GSR
Althouse Chemical Co.

Amanil Brown M
American Aniline Products, Inc.

Amanil Fast Brown RLH
American Aniline Products, Inc.

Amanil Brown CL Conc.
American Aniline Products, Inc.

National Erie Brown CN
National Aniline & Chemical Co.

National Erie Fast Brown 3RB
National Aniline & Chemical Co.

National Erie Fast Brown GR
National Aniline & Chemical Co.

National Erie Brown 3GN
National Aniline & Chemical Co.

National Erie Brown GB
National Aniline & Chemical Co.

Benzo Brown B
Croton Color & Chemical Co.

Benzo Brown G
Croton Color & Chemical Co.

GREEN

Amanil Green GG
American Aniline Products, Inc.

Amanil Green LT
American Aniline Products, Inc.

Direct Green B
Croton Color & Chemical Co.

Amidine Dark Green N
John Campbell & Co.

Amidine Green B Supra
John Campbell & Co.

Amidine Green BB Supra
John Campbell & Co.

Newport Direct Green B
Newport Chemical Works, Inc.

Newport Direct Green G
Newport Chemical Works, Inc.

Newport Direct Green CY
Newport Chemical Works, Inc.

Newport Direct Green 2GB
Newport Chemical Works, Inc.

Newport Direct Green 2YC
Newport Chemical Works, Inc.

Diamine Green B
Monroe Color & Chemical Co.

Chloramine Green B
Monroe Color & Chemical Co.

Pacco Green B
Palatine Aniline & Chemical Corp.

Essex Direct Green B
Essex Aniline Works, Inc.

Pontamine Green GX
E. I. du Pont de Nemours & Co.

Pontamine Green BX
E. I. du Pont de Nemours & Co.

Green Y
Althouse Chemical Co.

Direct Green G
Cincinnati Chemical Works

Direct Green B
Cincinnati Chemical Works

National Erie Green WT
National Aniline & Chemical Co.

National Erie Green MT
National Aniline & Chemical Co.

Centraline Green
Central Dyestuff & Chemical Co.

ORANGE

Newport Direct Orange R
Newport Chemical Works, Inc.

Newport Direct Orange 2R
Newport Chemical Works, Inc.

Newport Direct Orange 2RG
Newport Chemical Works, Inc.

Newport Direct Fast Orange RS
Newport Chemical Works, Inc.

Newport Toluylene Orange GR Conc.
Newport Chemical Works, Inc.

Essex Direct Orange R
Essex Aniline Works, Inc.

Essex Direct Orange 2RE
Essex Aniline Works, Inc.

Amanil Fast Orange 3G
American Aniline Products, Inc.

Amidine Fast Orange
John Campbell & Co.

Amidine Orange GG
John Campbell & Co.

Pontamine Orange 4G
E. I. du Pont de Nemours & Co.

Pontamine Orange R
E. I. du Pont de Nemours & Co.

Benzo Orange R
Monroe Color & Chemical Co

National Erie Orange Y
National Aniline & Chemical Co.

National Erie Orange 2R
National Aniline & Chemical Co.

National Erie Fast Orange A
National Aniline & Chemical Co

National Erie Fast Orange CG
National Aniline & Chemical Co.

Benzo Orange R
Cincinnati Chemical Works

RED

Bordeaux COV
Cincinnati Chemical Works

National Diazine Bordeaux N
National Aniline & Chemical Co.

Direct Bordeaux B2S
Althouse Chemical Co.

Amidine Bordeaux
John Campbell & Co.

Pontamine Bordeaux B
E. I. du Pont de Nemours & Co.

Benzopurpurine
Central Dyestuff & Chemical Co.

Benzo Purpurine 4B
Monroe Color & Chemical Co.

Benzo Purpurine 4B
Cincinnati Chemical Works

Du Pont Purpurine 4B
E. I. du Pont de Nemours & Co.

Du Pont Purpurine 4B Conc.
E. I. du Pont de Nemours & Co.

Du Pont Purpurine 10B
E. I. du Pont de Nemours & Co.

Newport Benzo Purpurine 4B Conc.
Newport Chemical Works, Inc.

Newport Benzo Purpurine 10B Conc.
Newport Chemical Works, Inc.

Delta Purpurine
Croton Color & Chemical Co.

National Erie Cardinal 7B
National Aniline & Chemical Co.

National Erie Congo 4B
National Aniline & Chemical Co.

Du Pont Congo Red
E. I. du Pont de Nemours & Co.

Congo Red
Althouse Chemical Co.

Newport Congo Red R
Newport Chemical Works, Inc.

Newport Congo Red 4B
Newport Chemical Works, Inc.

Congo Corinth G
Grasselli Chemical Co.

Congo Corinth
Central Dyestuff & Chemical Co.

Congo Corinth
Croton Color & Chemical Co.

Congo Corinth B
Monroe Color & Chemical Co.

National Erie Crimson B
National Aniline & Chemical Co.

National Erie Garnet B
National Aniline & Chemical Co.

Newport Direct Garnet B
Newport Chemical Works, Inc.

Newport Direct Garnet R
Newport Chemical Works, Inc.

Direct Brilliant Pink B
Althouse Chemical Co.

Direct Brilliant Pink R
Althouse Chemical Co.

Peerless Erika 2GN
Peerless Color Co., Inc.

Fast Pink
Grasselli Chemical Co.

Newport Direct Pink 2B
Newport Chemical Works, Inc.

Erika 2GN
Essex Aniline Works, Inc.

Essex Direct Brilliant Pink SX
Essex Aniline Works, Inc.

Essex Direct Pink NY
Essex Aniline Works, Inc.

National Erie Pink 2B
National Aniline & Chemical Co.

Pontamine Fast Pink BL
E. I. du Pont de Nemours & Co.

Direct Fast Red F
Butterworth-Judson Corporation

Amanil Fast Red F
American Aniline Products, Inc.

Pacco Direct Fast Red
Palatine Aniline & Chemical Corp.

Amidine Fast Red F
John Campbell & Co.

Centraline Fast Red F
Central Dyestuff & Chemical Co.

Newport Direct Fast Red F
Newport Chemical Works, Inc.

Pontamine Fast Red F
E. I. du Pont de Nemours & Co.

National Erie Fast Red 8BLN
National Aniline & Chemical Co.

National Erie Red 4B
National Aniline & Chemical Co.

National Erie Fast Red FD
National Aniline & Chemical Co.

Essex Direct Rose NB
Essex Aniline Works, Inc.

Essex Direct Rose FFB
Essex Aniline Works, Inc.

Direct Brilliant Rose B Extra
Peerless Color Co., Inc.

Amidine Fast Rose 2BL
John Campbell & Co.

Essex Direct Fast Scarlet B
Essex Aniline Works, Inc.

Pontamine Fast Scarlet 4BS
E. I. du Pont de Nemours & Co.

Pontamine Diazo Scarlet A
E. I. du Pont de Nemours & Co.

Pontamine Diazo Scarlet R
E. I. du Pont de Nemours & Co.

Amidine Scarlet B
John Campbell & Co.

Amidine Fast Scarlet
John Campbell & Co.

Direct Fast Scarlet
Althouse Chemical Co.

Newport Direct Fast Scarlet 6BX
Newport Chemical Works, Inc.

Newport Direct Fast Scarlet 8B
Newport Chemical Works, Inc.

Direct Fast Scarlet A
Peerless Color Co., Inc.

Direct Fast Scarlet R
Peerless Color Co., Inc.

Direct Fast Scarlet 3S
Peerless Color Co., Inc.

National Erie Scarlet B
National Aniline & Chemical Co.

National Erie Scarlet 3B
National Aniline & Chemical Co.

National Erie Fast Scarlet 4BA
National Aniline & Chemical Co.

National Erie Fast Scarlet 8BA
National Aniline & Chemical Co.

National Erie Fast Scarlet YA
National Aniline & Chemical Co.

National Diazine Scarlet M
National Aniline & Chemical Co.

VIOLET

Amanil Violet NC Conc.
American Aniline Products, Inc.

Amidine Violet R
John Campbell & Co.

Amidine Violet N
John Campbell & Co.

Pontamine Violet N
E. I. du Pont de Nemours & Co.

Direct Violet N
Central Dyestuff & Chemical Co.

Newport Direct Violet N
Newport Chemical Works, Inc.

Newport Direct Brilliant Violet R Conc.
Newport Chemical Works, Inc.

Direct Violet N
Butterworth-Judson Corporation

Direct Fast Violet 4B
Peerless Color Co., Inc.

National Erie Violet 2B
National Aniline & Chemical Co.

National Erie Violet 3R
National Aniline & Chemical Co.

National Erie Violet BW
National Aniline & Chemical Co.

YELLOW

Du Pont Brilliant Paper Yellow Conc.
E. I. du Pont de Nemours & Co.

Brilliant Yellow
Essex Aniline Works, Inc.

Newport Brilliant Yellow Ex. Conc.
Newport Chemical Works, Inc.

Chrysamine G
Cincinnati Chemical Works

Chrysamine
Althouse Chemical Co.

Amanil Chrysophenine G
American Aniline Products, Inc

Essex Chrysophenine Conc.
Essex Aniline Works, Inc.

Newport Chrysophenine Extra
Newport Chemical Works, Inc.

Direct Brilliant Flavine S
Peerless Color Co., Inc.

Primuline
Peerless Color Co., Inc.

National Primuline NAC
National Aniline & Chemical Co.

Newport Primuline Extra Conc.
Newport Chemical Works, Inc.

Cresotine Yellow R
Croton Color & Chemical Co.

Amanil Chloramine Yellow 2G
American Aniline Products, Inc.

Amanil Yellow CG Ex.
American Aniline Products, Inc.

Pontamine Yellow CH
E. I. du Pont de Nemours & Co.

Pontamine Yellow CH Conc.
E. I. du Pont de Nemours & Co.

Pontamine Light Yellow 5GX
E. I. du Pont de Nemours & Co.

Pontamine Fast Yellow L2RX
E. I. du Pont de Nemours & Co.

Pontamine Fast Yellow L3RX
E. I. du Pont de Nemours & Co.

Pontamine Yellow SX
E. I. du Pont de Nemours & Co.

Pontamine Yellow SXP
E. I. du Pont de Nemours & Co.

Pontamine Yellow GR
E. I. du Pont de Nemours & Co.

Essex Direct Yellow CF
Essex Aniline Works, Inc.

Essex Direct Yellow 2G
Essex Aniline Works, Inc.

Essex Direct Fast Yellow B
Essex Aniline Works, Inc.

Newport Direct Yellow G
Newport Chemical Works, Inc.

Newport Direct Yellow 3G
Newport Chemical Works, Inc.

Newport Direct Yellow SW
Newport Chemical Works, Inc.

Newport Direct Yellow GFA
Newport Chemical Works, Inc.

Newport Direct Yellow 4GC
Newport Chemical Works, Inc.

Newport Direct Pure Yellow S
Newport Chemical Works, Inc.

Newport Direct Fast Yellow NN
Newport Chemical Works, Inc.

Direct Fast Yellow FF
Peerless Color Co., Inc.

Direct Fast Yellow FF120
Peerless Color Co., Inc.

Direct Fast Yellow BO
Peerless Color Co., Inc.

Mimosa Yellow PC
Peerless Color Co., Inc.

Direct Fast Yellow AR
Peerless Color Co., Inc.

Amidine Fast Yellow 4G
John Campbell & Co.

Amidine Fast Yellow 5G
John Campbell & Co.

Direct Yellow
Central Dyestuff & Chemical Co.

Direct Yellow
Althouse Chemical Co.

Direct Fast Yellow AR
Cincinnati Chemical Works

National Brilliant Yellow C
National Aniline & Chemical Co.

National Erie Yellow Y
National Aniline & Chemical Co.

National Erie Yellow 2RF
National Aniline & Chemical Co.

National Erie Yellow F
National Aniline & Chemical Co.

National Erie Yellow KM
National Aniline & Chemical Co.

National Erie Yellow K
National Aniline & Chemical Co.

National Erie Fast Yellow WB
National Aniline & Chemical Co.

Multi-Color Effects in Simple Piece Dyeing

The Simplest Method—Loose Material—Tops—Differences in the Piece—Effect of Caustic Soda—Preparation of Wool—Variations—The Selective Principle—Some Recipes—Heather Mixture Varieties—Crossbreds

By REX CROSS

A LITTLE while ago, the daily papers spoke of two-color effects, dyed in one bath, as a remarkable new discovery. Technical "information" in the daily papers generally has something farcical about it for those in the know. Not only two-color effects but even three and four have been possible ever since union cloths were made.

In some directions these multi-color effects have been practised on a very large scale for many years. The general principle followed is that if a piece of cloth be composed of various portions, each of which has a different affinity for dyes, then when immersed in a dye liquor the differing affinities discover themselves in displaying differing colors.

The simplest method of doing it is to make cloth out of two or more fibers. Wool, cotton and silk, taken in pairs, or even all three together, and woven into cloth, can be dyed up from one bath with a separate color for each fiber. In fact, it is more difficult to get them all alike in shade than it is to get them different.

It is chiefly for this reason that union goods are the simplest to work with and have as a consequence been largely produced. When a cloth is all one fiber—e. g., all wool or all cotton—it is not quite so simple. To get two color effects here the commonest ways are by printing or by dyeing the material at some stage prior to weaving. The yarn may be dyed in hank or cheese or warp form, or the material may be dyed in its loose state. Printing is perhaps the cheapest way of getting multi-colored effects, though the actual printing processes may be intricate, highly skilled and numerous. Treating the material in yarn, or loose, though under some circumstances very cheap processes, especially the last named, yet result finally in a dearer cloth. It

is important to get a clear idea of the reason for this.

Loose Material

As regards dyeing loose material, this can be done in bulk with less expense as regards the mechanical handling of it in the dyeing than any other form in which the material may be. We say it *can* be—we do not say it always *is* done.

On the other hand, loose material requires more dyestuff for a given shade than either yarn or pieces. This is, we take it, because every fiber gets thoroughly impregnated with dye. When the fibers are twisted into yarn, those in the interior of the thread do not absorb as much as those which are on the surface, especially those which form what the spinner calls the "beard." When to the tightness of the twisting in the yarn is added the further interlacing which happens in the loom, it can be seen that a woven piece has a still greater proportion of its fibers that are mechanically protected against the dyeing operation.

It is the same principle on which, in the case of "random" yarns, portions of the hank are protected against the action of the dye by having a band tied round. Of course, in the random yarns the protection is, or is meant to be, absolute. While in pieces the protection is relative and the piece dyer often endeavors to overcome it by hard boiling, choice of very soluble dyestuffs, addition of Glauber salt, Turkey Red oil, etc. With some fabrics, and with the most soluble dyes, piece dyeing may result in very thorough penetration. But with fabrics made from very highly spun yarns, and tightly woven, the penetration may be very incomplete.

This applies specially to the fastest dyes. Dyes which go on easily often come off easily in washing or wearing. Colors which require a previous mordanting or a subsequent developing with chrome are likely to show inferior penetration to those which go on from simple solution. Goods dyed thus are liable to betray the fact in wearing. The parts subject to rubbing have the outer fibers worn away and those underneath show a grayness or thinness. The seams of a garment are particularly liable to show this appearance.

Objections

Thus, although the actual dyeing of loose material or yarn may be as cheap as piece dyeing, and though the result may be better dyeing, yet the increased cost prevents these methods being adopted as largely as piece dyeing. Where does the increased cost come in? In the first place, the material never seems to be improved in manufacturing qualities by wet treatment, and is usually deteriorated. Spinners always affirm that wool or cotton, dyed loose, never spins as well as in its natural state. It may be that the natural twist or curliness of the fibers is somewhat reduced. It is certain that the natural lubricant is either removed or altered. The dyeing process usually results in a little felting of the material, and in the opening or carding machines there is more breakage of fiber than there is when undyed material is put through.

Of these three objections to dyeing the loose fiber, we ourselves consider the second one as the most serious. As regards the first, it is quite possible for the curliness of the fibers to be increased and not reduced. In fact, increase of curliness may be one of the factors in felting, and under good conditions there ought to be no felting. In processes where the material is held tightly and the dye liquors pumped through, the material comes out of the machine, to all appearances, in beautiful condition. So we are left with the second reason as supplying most of the explanation for deterioration of the fiber.

We can, in imagination, think of the pores of the fiber, with or without natural grease in the case of wool, or wax in the case of cotton, like a football bladder with or without air. In the former case there is resilience and elasticity. In the latter case there is flabbiness. We have been told that worsted pieces dry cleaned before dyeing have a less value by pence a yard than similar pieces scoured in soap. Their handle has deteriorated. They feel papery.

Tops

Tops containing 1 or 2 per cent of oil and dyed without being scoured come out of the dyeing much loftier than tops that have been dry combed. Of course, it does not seem impossible that fiber robbed of its natural lubricant could not have some substitute given to it. The wool and worsted spinners certainly do add oil and to some extent correct the mischief. But there is room for research here, for it is universally considered that dyed material will not spin as fine as undyed by at least five counts. Material dyed in the loose state can go forward through the spinning and the preparatory processes of weaving pretty much like white material, except that it is usually in smaller lots, and there is the trouble of mixing the various colors. In the case of hanks the straightforward process for white piece goods has to be interrupted for the reeling into hank form and the rewinding.

In both these processes there is waste of material, besides loss of time. Dyed hanks also lose some strength and handle, and the weaving is more difficult owing to an increase of breakages.

The same applies to warp-dyed material. With elaborate patterns, the weaving has to be done with Jacquard looms, and these are much more expensive than plain looms in every way—first cost, running cost and output. It is because printing is done on cheaply woven goods that it is so much cheaper than Jacquarded goods. But this is getting rather beyond the scope we have set ourselves for this article. We wish

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

President
LOUIS A. OLNEY
Lowell Textile School, Lowell, Mass.

Vice-Presidents
WILLIAM D. LIVERMORE WILLIAM H. CADY

Secretary
WALTER E. HADLEY
5 Mountain Avenue, Maplewood, N. J.

Treasurer
WINTHROP C. DURFEE
516 Atlantic Avenue, Boston, Mass

Councilors
ELMER C. BERTOLET GEORGE A. MORAN
ARTHUR E. HIRST WILLIAM K. ROBBINS
WALTER M. SCOTT

LOCAL SECTIONS AND THEIR OFFICERS

Northern New England Section—
Hugh Christison, Chairman, Arlington Mills, Lawrence, Mass.
A. K. Johnson, Secretary, Lowell Textile School, Lowell, Mass.

Rhode Island Section—
Ralph F. Culver, Chairman, Box 269, Providence, R. I.
Leslie L. Bamberger, Secretary, U. S. Finishing Company, Providence, R. I.

New York Section—
P. I. Wood, Chairman, Oriental Silk Printing Company, Haledon, N. J.
L. C. Lewis, Secretary, 95 Madison Avenue, New York City.

Philadelphia Section—
Robert E. Rose, Chairman, E. I. du Pont de Nemours & Co., Wilmington, Del
Elmert C. Bertolet, Secretary, Philadelphia Textile School, Philadelphia, Pa

TENTH COUNCIL MEETING

The Tenth Council Meeting of the American Association of Textile Chemists and Colorists was held at the Engineers' Club, Boston, Mass., on Friday, November 10, 1922, the following members being in attendance: Prof. L. A. Olney, William D. Livermore, William H. Cady, W. C. Durfee, A. E. Hirst, George A. Moran, William K. Robbins, Dr. W. M. Scott, E. H. Killheffer, Ralph F. Culver, Hugh Christison, W. E. Hadley.

The following applicants were admitted to membership, as follows:

Active Membership

Brubaker, Carl H., 228 Gregory Avenue, Passaic, N. J.
Assistant Printing Manager, Passaic Print Works.

Burchill, Daniel, 132 Kearney Street, Passaic, N. J.
Foreman Color Mixer, Passaic Print Works.

Christison, Leslie, 52 Chestnut Street, Andover, Mass.
Chemist, Washington Mills, Lawrence, Mass.

Johns, Reinhold, 227 Central Avenue, West Hoboken, N. J.
Chemist, Passaic Print Works.

Lommel, George C., 1719 Woodbine Street, Brooklyn, N. Y.
Textile Chemist, John Campbell & Co.

Junior Membership

Hennessey, John H., 90 Stanwood Street, Providence, R. I.
Assistant Dyer, Apponaug Company, Apponaug, R. I.

MacIntyre, J. F., 24 High Street, Passaic, N. J.
Colorist, Newport Chemical Works.

Thompson, Jr., Arthur R., Bristol, Pa.
Textile Chemist, Rohm & Haas Company.

Toepler, Carl, 72 Woodland Street, Lawrence, Mass.
Assistant Chemist, Pacific Mills, Lawrence, Mass.

The question of the First Annual Meeting, which is to be held on December 2, 1922, at the Hotel Pennsylvania, was duly considered in detail.

E. H. Killheffer, Chairman in charge of arrangements, reported satisfactory progress.

Owing to the great interest exhibited by the members of the Association in the coming meeting, it was voted to hold a morning session beginning at 10 o'clock, at which time several papers will be read and discussed.

The afternoon meeting will begin at 2 o'clock, continuing throughout the afternoon. The banquet will be held in the evening, beginning at 6.45.

Invitations to the banquet will be mailed to all members about November 25. It is the intention of the Committee on Arrangements to invite persons outside the Association to attend this function. Any members who wish to have friends, or others who might be interested, included in the list of those to whom invitations will be sent should send their names and ad-

dresses to E. H. Killheffer, Newport Chemical Works, Passaic, N. J., not later than November 25.

The matter of the Annual Meeting is covered in a separate article in this issue.

A formal invitation to this meeting, together with the official program, will be forwarded by the Secretary to each member within a short time.

The various papers offered by the members, in response to the Questionnaire sent out some time ago, were considered by the Council, and the Secretary was authorized to notify six members that their papers were acceptable to the Council and that they could deliver same at the morning session.

On vote of the Council, it was decided that when Junior Members felt that they were fulfilling the conditions for Active Membership, that they were at liberty to address a communication to the Council, requesting that they be transferred accordingly.

Several amendments to the Constitution have been suggested and they will be included in the notice of the Annual Meeting which is soon to be sent to each member.

W. E. HADLEY, Secretary.

PROGRAM OF SECOND ANNUAL MEETING

The morning session will open at 10 o'clock in the Pennsylvania Hotel, Seventh Avenue and Thirty-third Street, New York City, Saturday, December 2, 1922, at which time the following papers will be presented and the subjects covered by them discussed:

Properties of Hydrosulphites and Sulphoxalates: Dr. Charles H. Hollander.

Why Silk Dyers Should Insist on a Report on the Quality of Raw Silk: L. C. Lewis.

Standardization of Cotton Piece Goods Finishing Processes and Organization: M. C. Dearing.

Application of Vat Colors in Calico Printing: Fred W. Whittaker.

Color Matching as a Factor in Accurately Rating the Relative Values of Dyestuffs: H. S. Busby.

Starch—Its Use in the Textile Industry: Dr. W. R. Cathcart.

The afternoon session will open at 2 o'clock, at which time the business meeting will be held, with the election of officers and whatever other business may properly be considered.

At 3 o'clock the following subjects will be presented for discussion:

(1) Discussion of Pressure Machine Dyeing, with Special Reference to Beam Dyeing.

(2) Methods of Determining the Strength of Dyestuffs.

(3) Discussion of the New Tariff Law as regards the interpretation of the following paragraph: "For the purpose of this paragraph, any coal-tar product, provided for in this act, shall be considered similar to or competitive with any imported coal-tar product, which accomplishes results substantially equal to those accomplished by the domestic product, when used in substantially the same manner."

Discussion of (3) will be introduced by representatives of the manufacturers, the importers, and the consumers, after which remarks will be in order from the floor.

(4) Discussion of the Fastness Tests as proposed by the Research Committee will be led by the Chairmen of the various Sub-Committees.

The evening session will open at 6.45 o'clock with a Banquet at the Pennsylvania Hotel. The speakers of the evening will be announced by mail.

More subjects were presented for discussion, on the return of the questionnaires, than could be assigned to the program. The above selections were made in order to cover those subjects in which the greatest interest was manifested, but should there be time an opportunity will be given for a discussion of various phases of Vat Dyeing.

PROPOSED AMENDMENTS TO THE CONSTITUTION

The following amendments have been proposed to the Constitution, same having been presented in writing to the Secretary, for presentation to the Council, at least four weeks prior to the Annual Meeting, such procedure being in accordance with the Constitution:

(1) Article defining the qualifications for Active Membership shall be changed to read: "The applicant must be engaged in *or directing* work related to the application of dyestuffs, etc."

(2) Article III, Paragraph 4, shall read as follows: "Any Corporation which is interested in the work of the Association may at the discretion of the Council be

admitted to a corporate membership which shall entitle it to all the privileges of active membership with the exception of voting."

(3) Article VI, Paragraph 2: "Annual dues for Corporate members shall be optional with the applicant; a minimum of twenty-five dollars being required."

(4) Article VIII: "If for any reason the official ballot shall fail to elect the entire number of officers and councilors, any vacancies shall be filled by special election at the annual meeting."

(5) Article XV: It is suggested that the duties of Local Secretaries be more clearly defined, and that the third paragraph be reworded as follows: "The Local secretary shall submit to the secretary of the Association an Annual Report of the proceedings of the Local Section each year, before February 1st of the succeeding year."

(6) Last paragraph of Section VI to read: ". . . within ten days of the holding of said meeting."

(7) The council may at its discretion offer prizes for the solution of textile problems, under such conditions as it may see fit to impose; and the Treasurer is authorized to furnish for this purpose from the funds of the Association an amount not exceeding $100 annually.

The following members have signed the proposed amendments in accordance with the Constitution: William D. Livermore, Alex. Morrison, Henry D. Grimes, George A. Moran, William H. Cady, Frank E. Kenyon, James L. Welpley, Walter W. Carr, Samuel Muirhead, William Woosnam, Charles L. Parker, John M. Hood, Leonard S. Little.

ORGANIZATION MEETING OF PHILADELPHIA SECTION

The organization meeting of the Philadelphia Section of the American Association of Textile Chemists and Colorists was called to order in the Committee Room of the Philadelphia Textile School, Broad and Pine Streets, Philadelphia, at 8.30 o'clock on Friday evening, November 10, 1922, with Elmer C. Bertolet, Secretary pro tem., appointed by the Council, in the chair.

After some remarks of a general nature leading up to this meeting, a motion to elect Dr. Rose temporary chairman was entertained and passed and Dr. R. E. Rose assumed charge of the meeting.

In accordance with the Constitution of the Society, a motion of Dr. Hollander to the effect that we organize a local section known as the Philadelphia Section was carried.

The following were elected to offices in the Section:

Chairman—Dr. R. E. Rose.
Treasurer—Dr. Charles S. Hollander.
Secretary—Elmer C. Bertolet.
Sectional Committee—
Dr. Donald S. Ashbrook,
Ralph A. McIntyre,
Carl E. Medde,
Charles E. Mullin.

The following committees were appointed:

Program Committee—
Charles E. Mullin, Chairman;
Edwin L. Duhring,
Ernest C. T. Bick,
George H. Schuler.
By-laws Committee—
Dr. Charles S. Hollander, Chairman;
W. G. Hamlen, Jr.
Membership Committee—
Percival Theel, Chairman;
Eric J. Monaghan,
Ralph A. McIntyre,
William Wall.

The future meetings will be held bimonthly, as follows: On the first Friday evening of January, March, May, 1923, at 8.15 p. m., at the Philadelphia Textile School. It was decided, however, that we will start the fall season next October and hold meetings bimonthly until June, the first Friday of the respective months being put aside for the meetings.

The following men were present at the meeting for organization: Edward L. Duhring, Charles E. Mullin, W. G. Hamlen, Jr., Dr. Charles S. Hollander, George H. Schuler, Eric J. Monaghan, Frank L. Remlein, Dr. R. E. Rose, R. W. Hunt, George W. Pressell, Sidney Bailey, Jr., Ralph A. McIntyre, Fred L. Nuttall, Carl E. Medde, Daniel Shea, J. H. McGlinchey, Elmer C. Bertolet, Percival Theel.

It is hoped that we will be able to have all men in the Philadelphia Section affiliate with it and take an

active part in the management of it. We are particularly anxious to increase the membership in this vicinity and so bring Philadelphia representation nearer what it should be for its importance as a textile center.

Remember our next meeting night, Friday, January 5, 1923, at 8.15 o'clock, at the Philadelphia Textile School. Program will be announced at a later date.

ELMER C. BERTOLET, Secretary.

A SUMMARY OF THE PROGRESS MADE TO DATE BY VARIOUS INVESTIGATORS IN AN EFFORT TO STANDARDIZE METHODS FOR DETERMINING THE FASTNESS OF DYES TO LIGHT

We are pleased to publish the following report by William H. Cady, Chairman of the Sub-Committee on "Fastness to Light." This report indicates the vast amount of work which should be done if anything like a satisfactory standard method for testing of fastness to light is to be devised. The list of references gives a very comprehensive bibliography of the literature in regard to testing of fastness to light.

The problem may be subdivided into two separate and distinct tasks: that of standardizing the source of light; and that of measuring and recording accurately the amount of fading.

It is obvious that the source of light must be either the sun or some artificial illuminant. As a fading agency, the sun is unsatisfactory for the following reasons:

1. Its intensity varies in different places and from hour to hour, owing to clouds, the position of the sun in the sky, and variations constantly occurring in the amount of radiant energy given off (1, 2).

2. Exposures to the sun are subject to further variations due to the variable moisture content of the atmosphere and to the presence or absence of carbonic and sulphurous acids which tend to accelerate fading (1, 2, 3, 4, 5).

3. Sun fading is too slow, especially in winter (6, 7).

To overcome objection 1, various attempts have been made to measure the sun's fading power so as to standardize it. Apparatus employed for this purpose includes: Bellani's Actinometer (8, 10, 11); the Montsouris Degree-hour Actinometer (10); Marchand's Apparatus (12); a Heliograph (9); other investigators have exposed a sealed tube containing Potassium Ferricyanide and determined the amount of Ferric Hydroxide formed (13), or have exposed a solution of Potassium Iodide and Sulphuric Acid and estimated the amount of Iodine liberated (1). All these methods are too complicated for practical use, and all are still open to objection 2.

The principal artificial lamps tried to date are: The Incandescent lamp (1,000 watt, nitrogen-filled); the Arc lamp (pure carbon, violet carbon, and white flame); and the Mercury-quartz lamp.

The incandescent lamp has a spectrum too unlike the sun to be a satisfactory substitute, and is too slow (2).

The ordinary carbon arc is more rapid and also more similar to the sun in regard to its spectrum, but is not a good substitute (6). The white flame and violet carbon arcs give fairly good imitations of average daylight. According to Gordon (7) the violet carbon arc is twice as rapid as August sunlight (when used at 10 inches distance from the sample). According to Mott (2) the white flame arc is 2½ to 5 times as rapid as June sunlight (same distance). It has the disadvantage of producing much heat, causing the samples to scorch unless properly air cooled; and the cost for current is considerable; but it probably comes closer to sunlight in its fading action than any other lamp tried to date. Various observers using the violet carbon arc have recently reported that it does not overheat the samples, and that it fades most colors in a manner very similar to sunlight; but that there are frequent exceptions where the fading is quite different.

The mercury-quartz lamp is quite different from the sun in its spectrum, being extremely rich in ultraviolet rays (7). It is the most rapid of all the lamps (at 18 inches distance, eight times as rapid as average sunlight) (14), but the results as a rule are too different from those of the sun to be dependable (6, 15).

Some colors are faded mostly by short waves, while others are more affected by long waves (16). Gebhard therefore proposes exposing samples to two lamps in succession, one rich in long waves (arc), the other rich in short waves (mercury-quartz) (4).

Taking up now the problem of measuring and recording the amount of fading, we find that the following methods have been employed:

1. Exposing the sample beside a standard of known fastness until the latter fades to a definite end-point, constituting one unit of light fastness. This method is particularly applicable to a variable source of light, such as the sun.

2. Exposing the sample until it fades, keeping an accurate record of the amount of light required: in the case of the sun, by means of actinometers, etc., as described above; in the case of artificial lamps, by noting the total hours of exposure.

Using method 1, the following standards have been employed:

Turkey Red or Indigo on cotton (Herzfeld) (17).
Victoria Blue R on filter paper (Krais) (18).

Eosine on filter paper (Robson) (19).
Victoria Blue B on silk (Scott) (20).
Indigo on cotton (Scheurer & Brylinski) (12). (The exposed Indigo dyeing is later extracted with acetic acid and the amount of Indigo destroyed by light is estimated.)
"A special series of standards dyed with selected colouring matters" (names not given) (Thorpe, etc.) (21).
Eight standard colors for cotton, ranging from fugitive to fast, and a similar list for wool (German "Echtheitskommission") (22).

Method 1 is criticised for the following reasons: It is difficult to get an exact end-point in fading the standard sample; it is unsafe to have only one dye as a standard for comparison with all other dyes, because some dyes are more susceptible to long waves and others to short waves, and because if a fugitive and a fast dye are exposed together in a poor light, the fast dye may not fade at all, since for every dye there is a certain light intensity which must be reached before the dye will fade (23); some colors fade rapidly at first and then cease to do so, while others are just the reverse (23, 24, 25); where colored filter papers are used, it is difficult to prepare them uniformly (23). It is also pointed out (24, 25, 26, 27) that since the fastness of a dyeing varies according to its depth of shade, it is extremely important that the unknown sample and standard shall be of equal intensity. In the case of two dissimilar colors, as for instance a blue and a yellow, the question as to what constitutes equal intensity is apt to become a matter of individual judgment.

The amount of actual fading in a sample is determined (a) by eye; (b) by means of a color-measuring device, such as Kallab's Color Comparator (28), Chevreul's Chromatic Chart (11), Stammer's Colorimeter (29), or Dosne's Tintometer (11); (c) by photographing the sample before and after fading, using an orthochromatic plate and a color filter (4, 16). None of the methods in (b) and (c) has ever been adopted to any extent; they all appear too complicated for everyday work.

To sum up the whole situation, it is rather significant that in spite of all the research work done in Germany and elsewhere with actinometers and artificial lamps, the German "Echtheitskommission" in 1913 definitely recommended the old-fashioned method of sun-fading, with dyed samples as standards. In view of the deficiencies of the sun, however, either a satisfactory method of standardizing sunlight should be found, or an artificial lamp (for instance, some type of arc) will have to be the alternative. In the latter event, more data should be available as to its relative fading power compared with sunlight, on all kinds of dyes and fibers; and means should be found for keeping the samples cooled without slowing down the fading action. It should be noted that valuable recommendations for standardizing the mechanical details of exposing the samples have been made by Scheurer (10), Gebhard (4), and Berner (25).

As regards the measuring and recording of fading, while some progress has been made, it cannot be said that any method proposed to date is satisfactory. Exposure in comparison with one or more dyed standards, preferably with the source of light standardized, seems likely to be the most acceptable method for the present; but more work is desirable in selecting the best colors for standards, in establishing the particular depth at which each color should be dyed, and in measuring the actual amount of fading.

There is also a need of further investigation of the effect of certain substances which accelerate fading, such as starch, alcohol, pyridine, and ammonia, and certain retarding substances, such as dextrine, chloroform, xylol, and acid vapors in general (1, 2, 30), in order to learn as much as possible about the laws governing these phenomena.

References

1. Brownlie: Remarks on the Chemical Action of Sunlight on Dyed Fabrics. J. Soc. D. & C., 26: 191.
2. Mott: Use of the Flame Arc in Paint and Dye Testing. Chem. Engineer, 22: 111. Abst. C. A., 9: 3130.
3. Wo̊scher: The Fastness of Dyed Colors to Light and Air. Zeit. f. Angew. Chem., 7: 211. Abst. J. S. C. I., 10: 634, and J. Soc. D. & C., 7: 108.
4. Gebhard: The Action of Light on Dyed Shades, and Standard Methods of Testing. J. Soc. D. & C., 26: 173. Abst. C. A., 4: 3005.
5. Hummel: Fast and Fugitive Dyestuffs. J. Soc. D. & C., 6: 187.
6. Straub: Fastness of Gray Military Fabrics to Light. Chem. Weekblad, 13: 1170. Abst. C. A., 11: 540.
7. Gordon: Testing the Fastness of Dyed Colors to Light. Tex. Col., 43: 29. Abst. C. A., 15: 2550.
8. Dosne: Method of Determining and Expressing the Fastness of Colors to Light. Bull. Soc. Ind. Mul., 1900: 207. Abst. J. S. C. I., 19: 1108.
9. Krais: The Light Fastness of Pigments from Coal-Tar Dyes. Z. Angew. Chem., 25: 2193. Abst. C. A., 7: 901.
10. Scheurer, Schoen & Wild: The Application of Actinometry as a Measure of the Resistance of

Colors to Light. Bull. Soc. Ind. Mul., 70:320. Abst. C. A., 2:710.
11. Dosne: Study of a Method of Determining the Fastness of Colors to Light. Rev. Gen. Mat. Col., 14:193. Abst. C. A., 5:200.
12. Scheurer & Brylinski: Means of Measuring the Action of Light on Colors. Bull. Soc. Ind. Mul., 1898:273. Abst. J. S. C. I., 18:137.
13. Bechtel: Use of the Prussiates of Iron in Measuring the Fastness of Dyes to Light. Rev. Gen. Mat. Col., 13:73. Abst. C. A., 3:2873.
14. Pierce: The Fastness of Dyestuffs to Light and Ultra-Violet Exposure. Color. Tr. J., 3:267. Abst. C. A., 12:2690.
15. Scheurer: Exposure of Cotton Dyes to Sunlight and Under the Mercury Quartz Lamp. Bull. Soc. Ind. Mul., 80:324. Abst. C. A., 5:1998.
16. Gebhard: The Establishment of a Uniform Method for Testing the Light Fastness of Colors. Farb. Ztg., 22:6, 26. Abst. C. A. 5:1518.
17. Herzfeld: Testing the Fastness of a Dyestuff. J. Soc. D. & C., 14:176. Abst. J. S. C. I., 17:842.
18. Krais: Proposed Scale for Measuring the Action of Light on Dyes According to Bleach Hours. Z. Angew. Chem., 24:1302. Abst. C. A., 6:1068.
19. Robson: A Method of Standardizing the Fastness of Colors to Light. J. Soc. D. & C., 34:185. Abst. C. A., 12:2250.
20. Scott: Standard Methods for Testing Dyestuffs. Am. D. Rep., 7:14 (Sec. 2). Abst. C. A., 15:1219.
21. Thorpe, Hummel, et al.: The Action of Light Upon Dyed Colours. J. Soc. D. & C., 9:219.
22. Standards and Processes Established by the Echtheitskommission. Mitt. k. Mat. Pruf., 34:153. Abst. C. A., 11:2963, and J. Soc. D. & C., 36:590.
23. Gebhard: Criticism of Krais's Proposal. Z. Angew. Chem., 24:1807, 2426. Abst. C. A., 6:1069, 2317.
24. Kischelt: The Action of Light on Textile Dyes. J. Soc. D. & C., 11:13; also J. S. C. I., 13:939.
25. Berner: On the Testing and Estimation of the Fastness of Colors to Light. J. Soc. D. & C., 8:192.
26. Dufton: The Fading of Colors. J. Soc. D. & C., 10:90. Abst. J. S. C. I., 13:633
27. Haley: The Fastness of Colors to Light. J. Soc. D. & C., 34:201. Abst. C. A., 13:188.
28. v. Klemperer: A Uniform Method of Testing Light Fastness. Farb. Ztg., 22:209. Abst. C. A., 5:3626.
29. Valenta: Printing Colors: Testing Their Fastness to Light. Oester Ch. Zeit., 3:265. Abst. J. S. C. I., 19:914.
30. Brownlie: The Chemical Action of Light on Dyed Colors. J. Soc. D. & C., 18:288. Abst. J. S. C. I., 22:23

THE TESTING OF DYES AND THEIR FASTNESS TO LIGHT UNDER THE QUARTZ MERCURY ARC LAMP

By S. W. Robinson

Hanovia Chemical & Manufacturing Company, Newark, N. J.

[*A paper presented before the meeting of the Northern New England Section, Engineers' Club, Boston, October* 21.]

Ever since the introduction of synthetic colors there has been a constant, ever growing necessity for a quick satisfactory method of testing the fastness of dyes to light. This problem has engaged the attention of chemists and engineers for many years. Since it is still engaging our attention to-day it is obviously a matter of considerable complexity. It may be of interest, then, to look into the difficulties of the problem and the methods by which it has been attacked.

Sunlight, whether direct or diffused, is a remarkably uncertain factor, both in quantity and quality, and it is the variations in quality with which we must primarily concern ourselves. The reason for this is not far to seek. Since the most active rays chemically are the ultra-violet, which are readily absorbed by smoke and clouds, it is immediately apparent what widely varying quality must be caused by varying atmosphere conditions.

Now, since that much-discussed individual, the ultimate consumer, has so far not indicated the willingness to buy a suit of clothes to be worn in cloudy weather, we must perforce presuppose the most trying conditions (for the dye, not the ultimate consumer) and make our tests accordingly.

What are the tests in use to-day and are they satisfactory? In the first place, we have the sunlight test which usually consists of exposing the dyed specimens under glass on the roof or some similar location where they will receive all the sunlight there is for one month.

The objections to this are too obvious to require discussion. It is too slow, the amount of sunlight in any particular month is quite uncertain, and glass screens out most of the active ultra-violet rays.

Many will remember that at the inception of the Dyestuffs Association in 1917, Dr. E. W. Pierce, of the U. S. Conditioning and Testing Laboratories, strongly recommended the adoption of ultra-violet light as the standard method of color testing.

Using artificial light sources, there are available the solid electrode arc lamps and the mercury vapor quartz lamps as alternative tests.

Through the high intensity of these lamps the duration of the test is very much shortened, which is a cardinal advantage. However, the distribution of en-

ergy over the various parts of the spectrum is not the same as that of sunlight, and this is where errors may arise if care is not used.

The carbon or other solid electrode arc develops great heat and care must be taken not to burn the colors, or indeed the fabrics. It also develops nitrous oxides and fumes, which are further disturbing factors, and it consumes quite a lot of current.

The mercury quartz lamp as generally used is air-cooled and generates ozone during its operation. The ozone will bleach or discolor many dyes which otherwise would be affected much less or not at all during the period of the test. Scheurer in the Bulletin Soc. Ind. Mulhouse, 1911, 80, 324, reported the testing of color fading under the quartz mercury arc lamp, and he was careful to protect the dyes from the action of ozone generated by the lamp. He refers specifically to indigo and several of the benzo colors.

Water-Jacketed Quartz Lamp

If, however, we arrange to water-jacket the quartz burner, the water serves to filter out those rays of wave length less than 2,000 Angstrom units, to whose action on the oxygen molecules the formation of ozone is due. The water also filters out the infra-red rays.

This being the case, the test samples may be safely brought close against the quartz wall of the water jacket, enabling the fading test to be carried through in a few minutes equivalent to a thirty-day sunlight test.

With the usual quartz lamp consuming 5 amperes on 110-volt direct-current circuit, one hour's exposure equals about 150 hours of average sunlight.

To carry out fading tests with an artificial light source whose intensity is dependent on a number of variable factors, such as voltage, current consumption, age of burner, etc., some comparative standard of intensity measurement is essential.

To this end use may be made in a quartz light radiometer of the rate of darkening of a standard silver chloride paper measuring the time required to darken it to a standard tint such as the one to be demonstrated. If we take as a convenient unit of quantity twenty-five times the amount of actinic light falling per unit area during the period required to darken the paper, we have a very convenient means of measurement.

For example, with this particular lamp construction the light intensity at 8 inches from the burner is one twenty-fifth that in immediate juxtaposition to the water jacket. If then the paper required fifteen seconds to darken, the test piece would receive one unit exposure in fifteen seconds against the water jacket, or in $15 \times 25 = 375$ (6¼ minutes) seconds exposed at 8 inches distance from the burner.

In this method of testing, while most of the difficulties of the problem have been overcome, it is not claimed to be the last word on the subject, since there is still present some difference in spectral character between any artificial light and natural sunlight. This factor must be constantly borne in mind. Of enormous value in this connection is a study of the absorption spectra and fluorescence of the dyestuffs themselves, as well as the chemical properties of the ultra-violet rays. Further, since photochemical action is brought about only by those rays which are absorbed, the influence of chemical constitution on the absorption spectrum is also of interest.

In general it may be stated that the dyes of the same group show definitely related absorption spectra influenced in the position and intensity of their bands by the nature and position of the substituent radicles. Also increasing numbers of double bands in the molecule induce greater ultra-violet absorption.

It is therefore frequently possible by studying the photograph of its absorption spectrum to learn a great deal about the structure of a given dye. It is even possible with dyes of similar chemical constitution to determine from their absorption spectra the relative fastness to light. This rule, that the greater the absorption in the ultra-violet the more rapidly will the dye fade, does not apply when comparing dyes of different constitution.

Many of the fluorescent dyestuffs function as catalysts in bringing about chemical decomposition by

light. Use is made of this property in the preparation of red sensitive photographic plates.

Bielecki and Henri have studied the influence of chemical constitution on the ultra-violet absorption spectra. Their work is to be found in Comptes Rendues, 1914, et seq.

They found, for instance, that an absorption band characteristic of the carboxyl group is displaced toward the red end of the spectrum by a carboxyl group in a conjugated position. Similarly two chromophores present in a molecule influence one another. If they occupy conjugated positions there is a displacement of the characteristic bands of each chromophore toward the longer wave lengths.

Magini showed as long ago as 1904, in the J. C. S., that, generally speaking, aromatic compounds possess very strong absorption spectra. He found a displacement toward longer wave lengths when hydroxyl groups are replaced by amino or carboxyl groups. On the other hand, the introduction of a second carboxyl group produced a displacement toward the shorter wave lengths partially or wholly counteracting the effect of the first carboxyl group. He found also that ortho and meta isomerides show analogous absorption, while the para grouping gives much stronger absorption, frequently quite independent of the other isomerides.

In this connection also we know that catechol and resorcinol show very similar absorption spectra, whereas the para isomeride quinol shows a strong absorption in the extreme ultra-violet, beginning at 2,500 amperes, not found in the spectra of the other isomerides.

Ley and Fischer, Berichte, 1913, investigating the absorption spectra and fluorescence of amido derivatives and imides in general, found that while the introduction of an amino group tends to throw the absorption bands toward the red end of the spectrum, the addition of acid to the solution of any amino imide displaces the spectrum toward the shorter wave lengths. Diphenylmaleic anhydride, chloraminomalein imide and similar compounds give fluorescent solutions when dissolved in various solvents, water, alcohol, ether and benzene, but the nature of the fluorescence is very much dependent upon the particular nature of the solvent. It would seem, therefore, that the phenomenon of fluorescence is intimately connected with the more or less complete dispersion or ionization of the fluorescent substance.

Quartz Light Radiometer

Wien has shown from theoretical considerations that a new absorption band should be formed when a substance fluoresces in light, and this has been confirmed experimentally by others. In other words, while in non-fluorescent substances the absorption constant is independent of the light intensity, in fluorescent substances it is a function of this intensity. All the rays of wave length falling within the absorption band of a substance are capable of exciting fluorescence—question of absorbing interest, although, as someone has aptly remarked, the question is one in which it is peculiarly difficult to make out what another man means and even what one means oneself.

*Spectral Absorption Data on Some Characteristic Dyestuffs**

Bordeaux B—Broad band yellow to violet; very strong in ultra-violet.

Bordeaux S—Broad band yellow to violet; very strong in ultra-violet.

Coccine—Broad band yellow to violet; very strong in ultra-violet.

Fast Red—Broad band yellow to violet; very strong in ultra-violet.

Dyes from Xylenazonaphthol—

Acid Magenta—Band covering green and blue; transparent in blue and ultra-violet.

Orange I—One band begins at yellow, invisible; one in ultra-violet, 3850.

Chrysone—No bands, invisible.

Naphthol Yellow S—One band in green; one in ultra-violet, 3850.

Auramine O—Has one band in blue, three in ultra-violet, 3500, 3100, 2650.

Fluorescein—One band in green blue, three in ultra-violet, 3350 to 2600.

Eosin—One band in green blue, one in ultra-violet, 3250 to 3450.

Erythrosin—One band in green blue; progressive; absorbs no bands.

Dichlortetraiodofluorescein—One band in green blue; progressive; absorbs no bands.

*Massol and Fancon, Bul. Soc. Chem, 1913; Meyer and Fischer, Berichte, 1913.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
PROFESSOR OF CHEMISTRY AND DYEING, LOWELL TEXTILE SCHOOL
Advisory Editor

LAURANCE T. CLARK
Managing Editor

Published biweekly by

HOWES PUBLISHING CO., INC.
4109 Woolworth Building, New York City

A. P. HOWES, *President* E. S. PREDMORE, *Secretary*

Subscription price $5.00 per year: Canadian $5.50; foreign $6.00.

Vol. XI November 20, 1922 No. 11

THE WRONG ROAD TO HARMONY

SO much has already been said concerning the 1923 Chemical Exposition fracas that perhaps a little more will do no harm, especially since this question is far from being at rest, and happens to be of interest to many REPORTER readers, directly and indirectly.

The latest development is a letter to all past exhibitors from Adriaan Nagelvoort, who is attempting to stage a "co-operative" Show under two roofs, in which the former manager takes the Advisory Committee to task for "such indifference to its responsibilities as to merit censure." The "opinion of a member of the New York bar" as to the alleged lack of action with respect to a fund representing part of the profits of the 1915 and 1916 Shows, for which the Committee is declared to be trustee, is given, and in this opinion such phrases as "indifference," "unbusinesslike conduct," and "very substantial non-feasance" are prominent. In other words, Mr. Nagelvoort appears determined, now that something in the nature of a row is under way and much linen, soiled or otherwise, is being aired, to have his say to the uttermost; nor will he, apparently, be disposed to hang back if an opportunity for discrediting either the Committee or the management of the previous Shows presents itself.

It may be remarked in passing that this would scarcely seem a logical way of proceeding toward harmony; moreover, the present complaint against the Committee appears to be so tenuous and of such doubtful importance that it is scarcely worth quoting here. Even Mr. Nagelvoort, in his letter, makes no attempt to follow up the advantage which he claims, and the whole thing has the appearance of a mere technicality, of not vital importance to the main issue, dug up by someone more concerned with putting the Committee in a bad light than with attempting to restore order to the Chemical Show situation. The motive appears to be provided by the action of the Committee in making "a united stand for the old management."

But with this letter, however, Mr. Nagelvoort encloses a copy of a letter from him to Dr. Charles H. Herty, chairman of the Committee, referring to a letter of Dr. Herty's to the exhibitors. Mr. Nagelvoort says:

"In your third paragraph you say that the purpose of the Chemical Show is to awaken public opinion to the part chemistry plays in our national welfare, and to arouse a sympathetic attitude in our bankers and investors and legislators. Can such an ideal be attained by Shows such as we have had? What exhibits have we had to show how chemistry makes paper, leather, cement, dyestuffs, soaps, chemicals, iron and steel or any of the chemical products necessary to our national welfare? We have had, it is true, many exhibits of things pertaining to our chemical industries in heterogeneous fashion, but not in an intelligent arrangement that could be understood by a banker or legislator or investor. The one branch of our chemical industry that needs help most, our synthetic organic chemical industry, was represented by a vacant booth from which was distributed pamphlets asking public support for this infant industry on the ground that organic chemical plants can be converted to war munitions plants—this at a time when the world is weary of war and tired of propaganda, and when nations are disarming to get relief from the heavy burdens of war taxation. If business conditions did not warrant the expenditure of the money necessary to make an exhibit to show the progress made in our manufacture of organic chemicals, the show itself should not have been held at all."

In writing thus, Mr. Nagelvoort reveals a lack of knowledge concerning one of the phases of the cause of the synthetic organic chemical industries which is astonishing in one aspiring to lead American chemistry out of the exposition wilderness. That the world is weary of war cannot be denied—most of it is financially incapable of carrying on even a third-rate war, anyhow—but if it is tired of chemical propaganda the fault lies in the propaganda itself, and not in what it stands for. That this propaganda has been far from perfect in form and distribution is also true, but to say that the need does not exist for impressing upon the American public just the very facts which Mr. Nagelvoort says this public no longer wants to hear, and which the makers of organic chemicals are still bravely trying to register in the American mind, is absurd. It is primarily because organic chemical preparedness is self-supporting and places no tax upon the country possessing it that it is so thoroughly in keeping with the most up-to-date thought on the avoidance of future wars. Likewise, the nations participating in the Limitation of Armaments Conference are all making extraordinary efforts to build up organic chemical industries of their own by means of special legislation insuring really adequate protection—except America. When the American public, and its legislators, grasp that fact and its entire significance, and act upon it accordingly, it will then be time enough to suggest that the subject of modern preparedness propaganda be given a rest.

Mr. Nagelvoort, in his letter to Dr. Herty, says that the latter has "conveyed the impression that you think I am the tool of foreign interests working to destroy our chemical industries. Of course you did not mean to convey such an absurd impression."

What Dr. Herty did or did not intend to convey, we, not having seen the letter in question, have no idea. But it would seem that if Mr. Nagelvoort persists in talking as he has above, he will eventually manage to convey such an impression himself, unassisted.

CHARLES J. TAGLIABUE

It is with regret that we publish an announcement of the C. J. Tagliabue Manufacturing Company, of Brooklyn, N. Y., recording the death on November 2 of its founder and president, Charles J. Tagliabue.

H. A. METZ & CO. ISSUE BULLETINS ON IMPORTED COLORS

Of no little interest to dye consumers should be four bulletins recently issued by H. A. Metz & Co., 122 Hudson Street, New York City, describing imported products of the Farbwerke vorm. Meister Lucius & Bruning, Hoechst-on-Main. These bulletins include some exceedingly excellent dyed samples showing results obtained with Acid Alizarine Brown RR, Chromogene Blue R pat., Brilliant Union Green G, and Helindone Fast Scarlet G Paste and B Paste. In the case of the last-mentioned, dyeing instructions are given in the bulletin, but samples and further instructions will be furnished upon application to the company.

Acid Alizarine Brown RR resembles the company's other Acid Alizarine Browns in its general properties, but is brighter and redder in tone of shade. It can be dyed as a one-bath color or upon a chrome mordant, and on account of its fastness is suitable for use in all classes of wool dyeing. Cotton is only slightly tinted when dyeing with this color, and hence it can be used for piece goods with cotton-effect threads.

Chromogene Blue R pat., while this new product may be applied as an after-chrome as well as a mordant dye, the former method of application is especially recommended.

The dye bath is prepared with 20 pounds Glauber salt and 5 pounds acetic acid. The goods are entered at a temperature not higher than 122 deg. Fahr., the temperature raised to the boil, and boiling continued for one-half hour. The dye liquor is then exhausted by adding 2 pounds sulphuric acid and boiling continued for thirty minutes. When the bath is sufficiently exhausted, the shade is developed with bichromate.

The proportions are for 100 pounds of material.

The fastness properties are: To sulphur, washing, water, carbonizing—very good; to fulling, potting, perspiration—very good; to light—good.

Brilliant Union Green G produces clean and brilliant shades of very good covering power. It dyes wool, cotton and silk evenly in a neutral bath previously prepared with Glauber salt

The dyeings produced on union goods with Brilliant Union Green G are of good fastness to rubbing, wearing, hot ironing and pressing, and are fairly fast to alkali and acid.

The most satisfactory results are obtained by dyeing the goods at the boil for forty-five minutes in a bath containing 20 to 40 per cent Glauber salt. After shutting off the steam the material is worked in the liquor while cooling until the cotton and silk are thoroughly covered.

Helindone Fast Scarlet G Paste and B Paste excel by their brightness of shade and fastness properties our former Helindone Fast Scarlets

Helindone Fast Scarlet G Paste and B Paste produce exceedingly fine scarlet shades on cotton, linen and other vegetable fibers, the G brand producing yellowish and the B brand bluish shades.

The two brands may be used in combination with each other in any proportion, or with Helindone Orange R and Helindone Pink R Extra, so that all shades from bluish red to orange may thereby be obtained.

The dyeings obtained with Helindone Fast Scarlet G Paste and B Paste are exceedingly fast to washing, boiling and chlorine, and, if the usual precautions for dyeings with vat colors are observed, they are also fast to kier-boiling. The fastness to light also is very good.

As the solubility of both brands is good, they are suitable for machine dyeing.

Helindone Fast Scarlet G Paste and B Paste are therefore of great value for the production of all kinds of fast shades, and in view of their good penetrating power they are specially adapted for the dyeing of mercerized pearl yarn.

Helindone Fast Scarlet G Paste and B Paste yield very bright and fast red and scarlet shades for printing are spraying colors for the printing of calico and silk. They may also be used for discharge printing and resist styles.

DU PONT ANNOUNCES PONTAMINE CATECHU B AND G, AND SULFOGENE BRILLIANT GREEN 2G

The Dyestuffs Department, Sales Division of E. I. du Pont de Nemours & Co., announces placing on the market Pontamine Catechu B and Pontamine Catechu G, the former being a direct brown of a yellowish shade and the B brand a new direct brown of a dark violet brown cast.

These two products, like the company's Pontamine Catechu 3G, previously offered, are important direct colors for cotton, particularly when after-treated with chrome and copper, which after-treatment dulls the shade only very slightly but increases the fastness properties, especially to water and light.

The company also has a new Sulphur Green designated as Sulfogene Brilliant Green 2G, a color very adaptable for pad work and also for use in a circulating machine, especially of the beam dyeing type.

It can be applied equally well on raw stock, cops, piece goods, and hosiery. It has good fastness to light, cross-dyeing, washing, mercerizing and water.

AMERICAN ANILINE PRODUCTS ACQUIRES CONTROL OF AMERICAN VAT COLOR COMPANY OF CHICAGO

The American Aniline Products, Inc., 80 Fifth Avenue, New York City, has acquired control of the American Vat Color Company of Chicago and has reorganized it under the name of the American Vat Color Manufacturing Company, with main offices at 80 Fifth Avenue, New York City.

Ample working capital has been provided, according to an announcement issued by American Aniline Products.

Algol and Indanthrene colors are being manufactured, and inquiries for such colors are invited.

MULTI-COLOR EFFECTS IN SIMPLE PIECE DYEING

(*Continued from page* 378.)

specially to draw attention to two or more colored effects on materially wholly of one fiber (wool) done in one dye bath.

Differences in the Piece

Going back to the principle enunciated in our first paragraph, a piece which comes from the loom, apparently all alike, must have some differences in its constituent material if a dye bath is to produce multicolored effects. The greater the differences in the fabric material and the bigger contrast in the different colors that may be produced.

Many ways have been tried for giving free treatment to a portion of the raw material, followed by subsequent mixing with untreated material. The mixing may be done in the carding or combing, when heather results will be obtained in the after-dyeing. Or the treated material may be spun to itself and mixed with untreated yarn in the warping or wefting. This would result in stripes, checks or other woven effects.

Almost any chemical treatment will alter the dyeing capability of wool. Even boiling in pure water would do something. An acid treatment with hydrochloric or sulphuric acid will leave the wool white, but with decidedly different affinity for dyes compared with untreated wool. Suppose a piece of cloth to be made of part ordinary wool and part acidified. If dyed up in a bath containing acid colors but no acid, the acidified wool would take most of the dye. The effect would be that of full shades and tints. Treatment with nitric acid would give a yellow color to the wool.

Effect of Caustic Soda

Treatment with very weak caustic soda considerably alters the affinity for dyes. The soda must be *very* weak and can act cold. The acids are best applied hot. We believe its use was once patented for this purpose.

Treatment with chlorine increases the affinity of wool for most dyes. Bleaching with either sulphurous acid or peroxide of hydrogen considerably alters the behavior of wool to dyes—sometimes the affinity is increased and sometimes it is decreased; and, of course, the bleached effect is added to the other. Mordanting at some stage before weaving and dyeing up afterward has been tried.

Resisting wool with tannic acid and tin salts has been used as a method for getting results afterward in piece dyeing.

Preparation of the Wool

Thus there is much choice in preparing wool to be worked up with untreated material. But an obvious criticism of these methods is that they are in themselves only a little less costly than actual dyeing, and they interfere with the straightforward preparation of the wool for the loom almost as much as dyeing does. A partial answer to this is that some of these treatments could be done at much less cost than actual dyeing, and might almost be included in some of the actual processes.

For instance, much wool is scoured in a processional plant of three bowls. We have, indeed, seen wool scoured in two bowls. An extra bowl adds very little to the cost, and practically none to the time. If the wool passed through a fourth bowl containing any of the reagents mentioned, with the possible exception of tannic acid, it would have its dyeing affinity altered from normal at next to no cost.

Variation in Wool

An obvious retort is, why not use the fourth bowl for a dyeing liquor? To this we reply, why not? It is a perennial source of surprise to us that this is *not* done. The answer to the conundrum would necessitate a long explanation, which may be briefly summarized by saying that this simplest and cheapest way of dyeing is put out of court by limitations put on the technical side of manufacturing by the commercial end. But the ordinary scouring process could be worked by a skilled man so as to give scoured stock of very varying affinities for dyes. The ordinary haphazard ways of scouring do it in a casual and haphazard fashion. Every dyer knows that a recipe for a shade is not certain to give the same result every time, because dif-

ferent lots of wool take the dye differently. The reasons for this are many.

Wool from different flocks may have similar spinning qualities but will show differences in the dyeing —naturally. No wool merchant could guarantee exact quality month after month and year after year. He might satisfy the top maker or the spinner. That is, he might guarantee that his various lots will spin to a certain fineness. But as regards dyeing and finishing properties, it is humanly impossible to say that a blend to-day is exactly like one of six months ago.

Apart from this, the scouring of the wool, while not betraying any variation to the spinner, may show tremendous latitudes to the dyer. We remarked that caustic soda must only be applied to wool in very weak solution. The causticity of the scouring baths may not be such as to show much difference in the handle of the dry wool, but we believe they have a quite noticeable effect on the dyeing properties.

To give an illustration. We have seen a dyeing machine charged with wool of two runs. Both runs were equal in spinning qualities and handle; from the point of view of the spinner they were practically alike. During the dyeing the two runs had exactly the same treatment. They were packed in the machine so that they could be taken out separately after the dyeing, but in the actual dyeing they were both in the same liquor together and subject absolutely to identical conditions.

Nevertheless, one came out a good shade darker than the other. The stuffing was 8 per cent of dye, but approximately the result may be described as one run having a 9 per cent shade and the other a 7 per cent. This difference may have been caused by one lot having had a more caustic scouring than the other —not a causticity sufficient to injure the strength of the wool, but enough to alter its affinity for dyes. Thus the scouring process could be worked or adjusted so as to provide a means whereby piece dyeing could develop two distinct shades—as we will describe shortly.

(*To be concluuded.*)

PROPER HANDLING OF CHEMICALS

Systems in mills vary, but it is a good plan to allow the color mixer to be in charge of acids and chemicals as well as dyestuffs. If kettle hands weigh out their own acid or Glauber salt, there is apt to be more mistakes for one thing and greater waste for another. Glauber salt, if it comes in bags, should be emptied into a large wooden salt box and the pails filled inside the box. If the men fill their pails from the bags a large amount of salt falls to the floor and becomes too dirty to be used with any degree of safety.

It is well, in adding Glauber salt to the machines, to place it in several strong cotton bags whose open ends are tied securely with strong rope. In this way the bags hold back all insoluble foreign material, such as nails, splinters and dirt, or anything, in fact, which might possibly get into the kettles and tear or stain the goods. The bags should be tied securely, one on each side of the kettle. In any event, they should be kept clear of the steam pipes.

The workman should be instructed very carefully in the use and handling of acids, and of sulphuric acid in particular. Vitriol—sulphuric acid, as it is generally called in the trade—comes to the mill in carboys containing about 12 gallons. In trucking carboys of vitriol, it is quite dangerous to use the ordinary type of warehouse truck, because there are no means of holding the container in place. However, several types of trucks are on the market which are safe to use. One has a fork arrangement, "one prong of which passes on each side of the carboy box and beneath the side cleats." This type of truck lifts the carboy clear of the floor, and can be operated successfully by one man.

Under no consideration should the men be allowed to pour out acid by hand. It is best to use the ordinary type of inclinator, only taking care that the carboy is held firmly in place. The men should be instructed never to add water to the concentrated vitriol, but rather vitriol to water. The danger of using hot or even warm water with vitriol should be carefully explained. So much for chemicals.

Every kettle hand should be supervised closely when he dissolves his dyestuff and adds the solution to the dyeing machines. Perhaps the best scheme is to boil up all colors except blacks possibly. Steam-jacketed copper kettles of about 5 gallons' capacity have been recommended, but many dyers like to avoid all utensils of copper, especially when chrome colors are being used. An economical means of accomplishing the same results consists of cutting a number of strong wooden barrels in halves. These half barrels should be placed on a wooden stand or framework, high enough above the floor to permit one's placing a pail and sieve under a spigot inserted in each tub. Steam pipes should be carried into each half barrel.

The dyestuff and a suitable quantity of water should be poured into the tubs, the steam turned on and the contents stirred at a boil until all the color is dissolved. The solution is then sieved into the pails and added to the kettles. A certain number of tubs should be assigned to navy shades, others to greens, browns, reds, etc. Black do not require such treatment (we are speaking altogether of acid colors), and light and even medium shades often may be boiled up in pails, sieved in the usual manner, and give good results. Some mills use such kettles only for shades which give them the most trouble, while others even boil up medium and light shades.—Canadian Dyer and Color User.

The fifty-first annual dinner of the Silk Association of America will be held February 3, 1923, and will precede the International Silk Exposition, opening February 5.

MORDANTS

In Three Parts—Part III

By WILDER D. BANCROFT
Professor of Chemistry, Cornell University

An Article in the Journal of Physical Chemistry Published at the University and Reprinted by Permission

Note—References will be found at the conclusion of this installment, p. 398

(Part II was concluded in the issue of September 25.)

CHROME

Wool and Bichromate

ALTHOUGH the use of chromic oxide as a mordant with dyes other than logwood only goes back about seventy years, Liechti and Hummel[1] stated in 1893 that "the most important mordants in wool dyeing are certainly the chromium mordants—indeed they have been called the mordants of the future." Only ten years later, Ganswindt[2] said that ninety-eight percent of all the mordanting of wool is done with chromic oxide. Matthews[3] said that "chromium mordant is used for dyeing practically all of the alizarin, mordant, and acid-mordant or afterchromed dyes; it is also the principal mordant used in conjunction with the natural dyewoods."

Instead of starting with the chromic salt, as would naturally have been expected, chromic acid in the form of bichromates of potassium and sodium is the most important and most generally used wool mordant.[4] Matthews[5] says that "formerly potassium bichromate was used almost entirely; but, during the recent war, potassium salts were very scarce, and even before the war sodium bichromate was coming into vogue as a mordant, as the sodium salt was cheaper than the potassium salt. In former times the potassium salt was preferred owing to the fact that it crystallized nicely and could thus be prepared very pure and free from iron (which is very essential in its use as a mordant for most colors), whereas the sodium salt was difficult to obtain in a crystalline condition, and, furthermore, it deliquesced on exposure to the air and became pasty and hard to handle. Modern and improved methods of manufacture, however, developed a crystalline form of sodium bichromate in a highly purified state and it rapidly displaced the sodium salt."

In a bichromate solution wool, of course, becomes yellow; but neither bichromate or chromic acid is really a mordant in itself. Liechti and Hummel[6] say that "the [wool] fibre itself is incapable of really fixing chromic acid as such, as some maintain, and during washing, especially in hot water, a larger or small quantity is dissolved from the fibre. So much, indeed, is this the case that some have been led to declare that the mordanting of wool with bichromate of potash is of a purely physical nature, since by washing nearly the whole of the chromium may be removed." Whitely[7] did not succeed in washing out all the chromic acid; but recent experiments at Cornell are quite conclusive to the effect that there is no very strong adsorption of chromic acid by wool. Since chromic oxide is the real mordant, mordanting with bichromate involves a reduction. The chromic acid may react with the wool fiber, with the dye, or with reducing agents added to the bath. There seems to be no question but that chromic acid reacts with wool under suitable conditions. In the light the color of the wool changes from yellow to green and, in the dark, reduction always takes place[8] if the wool is kept in the bath at 100° for an hour and a half, the wool becoming a brownish yellow or pale olive color. In another eperiment "wool was saturated with solutions of potassium chromate and bichromate of such a strength that the amount of mordant absorbed was equivalent to the use of three percent bichromate of potash [on the wool] in the ordinary manner. After drying, the fents were steamed, and in this way not only was the bichromate, but even the chromate of potash almost entirely reduced, particularly the former, presumably according to the following equations:

$$K_2Cr_2O_7 + 4H_2O = Cr_2(OH)_6 + 2KOH + 3\,O$$
$$2K_2CrO_4 + 5H_2O = Cr_2(OH)_6 + 4KOH + 3\,O.$$

This experiment demonstrates conclusively the fact that reduction may be effected by the wool fibre itself, and one need not necessarily therefore adopt Nietski's view, that, owing to the amido-acid character of the wool fibre, both K_2O and CrO_3 are fixed simultaneously."

When the reduction takes place at the expense of the wool fibre the latter may easily be weakened thereby. There has been a good deal of discussion over this and von Kapff has urged the substitution of vat dyes for mordant dyes[9] on the ground that in Germany alone the annual damage to wool from chrome mordanting amounts to 250 million marks. Others claimed that the damage is relatively small. The truth of the matter is that a reducing agent is usually added, either by itself or in the form of dye as in the case of logwood. The amount of

oxidation of the wool is small at most because one usually adds three percent of potassium bichromate on the weight of the wool and only about one-third of this is adsorbed. Liechti and Hummel[10] estimate that this means, in round numbers, about one hundred grams of wool, in case the chromium is fixed, as they assume, in the form of a chromic chromate, $Cr_2(CrO_4)_3$, from which the chromate is afterwards washed out.

If an oxidizable dye is used, the dye will reduce the chromic acid, which will therefore not attack the wool. Matthews[11] says that potassium bichromate and sulphuric acid "in connection with logwood oxidize the hematoxylin to hematine and thus utilize the coloring matter completely. If the ordinary chrome and tartar mordant is employed, a green reduced chromium oxide is obtained on the fibre which has no oxidizing properties; consequently, on dyeing with logwood, the color obtained is chiefly due to hematine and the hematoxylin is not utilized completely. This accounts for the fact that different dyers may obtain entirely different results with the same lot of logwood extract."

Liechti and Hummel[12] have proved that alizarin alone, in the absence of wool, is capable of reducing alizarin. "With the presence of wool the reaction proceeded even more favorably. Along with one gram alizarin (20 percent paste) the theoretical amount of bichromate of potash was employed, viz., 0.082 g; also the following amounts: 0.123, 0.164, 0.205, 0.246, 0.328 grams. The wool was entered into the bath at 40° C and then boiled for two hours. All the baths contained lake, which gradually increased in quantity from baths one to six. All had a neutral reaction and were totally free from alizarin. No. 1 contained the merest traces, No. 2 slightly more, and the rest gradually increasing amounts of chromate of potash. Notwithstanding the absence of lime salts, the dyed wool stood soaping very well, and all the colours were bright claret reds, very similar to each other in shade. It must not be forgotten, however, that the wool itself contained a little lime. Cotton submitted to the same process merely acquired a pale peach colour, while the bath contained a good deal of lake."

"If a filtered aqueous solution of Coerulein S, made in the cold, is heated with not too much bichromate of potash, a fine colour lake is obtained. If there is a deficiency of readily oxidisable substances present, then the wool itself continues and completes the reduction. This fact can be established experimentally, for in no single case did we ever succeed in detecting chromic acid in the dye-bath.

"In most cases of dyeing an oxidising action on the part of the mordant is undesirable, and in some cases it is absolutely injurious, hence many attempts have been made to reduce the chromic acid entirely before dyeing. The method proposed some time ago by Knecht, namely, by the use of sodium bisulphite, effects this in the simplest manner; but this method has long been known, for already in 1853 C. Koechlin mordanted wool with bichromate of potash, and after washing, effected reduction by means of sodium bisulphite, repeating the operations four or five times. Witt, too, has long adopted the same method. In 1881 one of us used the method with silk. Further, in 1866, Chaudet recommended the treatment with a variety of reducing solutions after mordanting—e. g., sulphurous acid, alkali sulphides, organic acids, alcohol, sugar, etc. Grison too, who recommends 1.5 percent $K_2Cr_2O_7$ + 8 percent H_2SO_4, effected reduction by means of sodium bisulphite, or by using a solution of arsenious acid (10 grams per litre), treating the mordanted material with this until it acquired a green colour, and repeating the operations if necessary. Then again, in 1857 Francillon padded wool or silk in bichromate of potash or chromic acid, and effected reduction after a few hours, by hanging the materials in the sulphur stove or by means of a solution of sulphurous acid."

"Nietzki suggests that the ultimate dyed colour produced is due to a triple combination of wool, colouring matter, and chromic acid. There is, however, no fact which can be advanced in favor of this supposition, and we have always been inclined to adopt the view, shared also by Herzfeld and by Witt, namely, that in the dyed colour the chromium exists as a chromic oxide lake, reduction taking place chiefly by means of the foreign organic substances which almost always accompany the colouring matter employed, sometimes by the impurities contained in the water (Cochenhausen), frequently by the colouring matter itself, as in the case of logwood, and lastly by the sulphurous acid of those colouring matters which have been rendered soluble by combination with sodium bisulphite."

Chromic acid mordants wool more strongly than either potassium bichromate or chromate. Knecht states[13] that with neutral potassium chromate only thirty-six percent and with potassium bichromate only forty-eight percent of the amount of chromium is fixed as when wool is boiled in a bath of chromic acid itself. Liechti and Hummel say that "most authors agree with us that chromic acid mordants better, that is stronger, than bichromate of potash. Most recommend 3 percent $K_2Cr_2O_7$ + 1 percent H_2SO_4; Lodge gives 2 percent H_2SO_4; and Kertesz, 3 percent H_2SO_4. Nietzki observed on using excess of sulphuric acid, e. g., 3 molecules, that the chromic acid is taken up rapidly and almost completely by the wool. This observation agrees with ours; but it is difficult to understand why his samples appeared yellow after washing, since ours had invariably a greenish-brown or olive colour, sometimes the green (chromic oxide), sometimes the brown (chromium chromate) predominating. Leaving out differences of intensity the colour varied from a pale reseda colour to pale olive."

In a later paper Hummel and Gardner[14] modify this statement somewhat, because they find a maximum mordanting with about 1.5 mols sulphuric acid. "A series of six wool patterns was mordanted with three percent $K_2Cr_2O_7$ (1 mol) with the addition of 0, 0.5, 1, 1.5, 2, 3 mols of H_2SO_4. The mordanted patterns varied in colour from a drab-white in No. 1 to a pale olive-yellow in No. 4, after which from No. 4 to No. 6 the colour became distinctly greener. The mordant liquor of No. 1

had a pale greenish-yellow which gradually became slightly paler up to No. 6. The addition of sulphuric acid up to 1.5 mols results therefore in an increased fixation of mordant, from which point with larger proportions of acid the amount of reduction increases." In a second set of experiments "larger variations in the amount of sulphuric acid were employed, three percent $K_2Cr_2O_7$ being used with 1.5, 3, 4.5, 6, 7.5, 9 mols H_2SO_4. No further information was obtained, the addition of 1.5 mols H_2SO_4 again giving the maximum fixation, while with 3 mols partial reduction of the chromic acid occurred and with increased amounts of acid the reduction was somewhat greater."

This statement is typical of what one encounters when reading papers on dyeing. The conclusion may be right; but it is in direct contradiction with the facts as stated. Hummel and Gardner say that the waste mordant liquor in the first set of experiments becomes increasingly paler, with increasing amount of acid. If this is true, there is less chromium in the bath and consequently more has been taken up. They are really talking about the adsorption of chromic acid as such, though they speak of the fixation of the mordant. The fact that the wool becomes greener shows that there is less free chromic acid but not that there is less chromium.

Experiment swere also made with three percent $K_2Cr_2O_7$ (1 mol) and 0, 1, 2, 3, 4, 6 mols of hydrochloric acid. The appearance of patterns Nos. 1, 2, and 3 was similar to the corresponding ones in the series with sulphuric acid. "A very remarkable difference, however, was shown in patterns Nos. 4, 5, and 6, which here had a pronounced olive-yellow colour. In accordance with this gradual increase in colour of the mordanted patterns, there was a corresponding decrease in the colour of the waste mordant liquors, in which, from No. 4 to 6, the colour was much paler than in the corresponding waste liquors of the previous experiment; indeed Nos. 5 and 6 mordant baths with 4.5 [4.0?] and 6 mols HCl were almost entirely exhausted. A continuation of this experiment, using larger amounts of hydrochloric acid (6–16 mols), showed that 6 mols sufficed for the fixation of the chromium chromate, and that larger amounts merely caused a further slight reduction; but even with 16 mols the reduction was far from complete when three percent bichromate was used.

"The corresponding experiments with nitric acid indicated that the use of this acid gives a result very similar to that obtained with hydrochloric acid; the mordanted patterns showed the same deep olive-yellow colour and the waste liquors were equally well exhausted. The amount of nitric acid necessary to give the maximum amount of fixation of mordant was indeed somewhat less than in the case of hydrochloric acid, 4–5 mols only being required. Excess of nitric acid appeared also to induce a somewhat greater degree of reduction of the chromium chromate than excess of hydrochloric acid."

Here again there is no evidence of any maximum fixation of chromimum mordant. The only two things which the experiments prove—and that only qualitatively—are that hydrochloric and nirtic acids exhaust the bath more completely than does sulphuric acid, and that reduction of chromic acid by wool takes place more readily with sulphuric acid than with hydrochloric or nitric acid.

We can now consider what one can predict in regard to these matters. It seems probable that wool first adsorbs chromic acid, which is not held strongly enough to be a real mordant and which is reduced under certain circumstances to chromic oxide which constitutes the real mordant. It is of no special importance whether there is an intermediate formation of a chromium chromate or what that chromium chromate is. It is of interest only in accounting for the intermediate color because everybody admits that the chromate part of the hypothetical chromium chromate can be washed out of the wool and that this substance is not the mordant. It is clear that wool will take up less chromic acid from a potassium chromate solution than one containing free chromic acid. Other things being equal, more chromic acid will be taken up the more acid we make the solution; but other things are not equal because we cannot add hydrogen ions without adding anions to correspond. If we add an acid which is adsorbed strongly in itself, it will tend to displace the chromic acid. This is probably the reason why sulphuric acid does not exhaust the bath of chromic acid so rapidly as does nitric or hydrochloric acid. In line with this is the fact that a mixture of sodium chloride and sulphuric acid behaves like so much sulphuric acid and not at all like hydrochloric acid. The sulphate ion is apparently an important factor. With increasing acid content there will come a point where the chromic oxide formed will be peptized or converted into a soluble acid. It is hard to tell whether this is a factor or not. Hummel and Gardner[15] say that "a careful examination of the waste mordant liquors showed that although the exhaustion of the bath appeared complete when using 4 mols H_2SO_4, it really contained a notable amount of chromium in the reduced condition."

We have now accounted tentatively for all the facts except the difference in the reduction of the chromic acid when sulphuric and hydrochloric acids are used. It seems better to admit frankly that my knowledge of chemistry is not sufficient to enable me to give a decisive answer on this point. We do know that chromic acid is a stronger oxidizing agent the more acid the solution. When the reduction is done by the wool, the acidity in or at the wool surface is the more important thing. If the sulphuric acid is adsorbed more strongly under these conditions than the hydrochloric acid, the acidity, and therefore the oxidizing power, may well be greater in the sulphuric acid solutions than in the ones containing an equivalent quantity of hyrochloric acid. This is only a suggestion, however, and there are no data.

Since percentage adsorption of chromic acid will decrease with increasing concentration, we should expect any acid to exhaust the bath more completely the lower the initial concentration of the bichromate. This is ex-

actly what happens. Hummel and Gardner[16] found that with one or two percent potassium bichromate a small addition of hydrochloric acid was sufficient to exhaust the bath, while the four percent bath could not be exhausted completely by any acid concentration that was tried.

Knecht[17] points out that "if a large excess of bichromate is used, especially in conjunction with sulphuric acid, it exerts an injurious effect on some colouring matters by oxidising them and destroying their colouring principles, while at the same time the fibre is injured. Wool so treated is said to be "overchromed." Small amounts of bichromate do not exert this influence to so large an extent, but the products of oxidation diminish the brilliancy of the ultimate colour more or less, and the excess of mordant bleeds out and precipitates the colouring matter in the dye-bath, and this being taken up more or less mechanically by the wool gives rise to colours which rub off. The reduction of the bichromate previously to dyeing not only prevents this loss from overchroming, but also, by checking the decomposition of the colouring matter, allows of more brilliant shades being obtained."

Reference has already been made to the possibility of reducing the chromic acid with sulphurous acid or bisulphite but the more customary thing is to use an organic acid instead of sulphuric or hydrochloric acid.[18] "When sulphuric acid is used as the assistant along with the bichrome, then there is formed on the wool a deposit of chromic acid and chromium oxide, and this exerts an oxidising effect on the colouring matter or dye-stuff, which in some cases, as the Alizarine Blue, Alizarine Yellow, etc. leads to a destructive effect, and, therefore, the production of weak shades, so that it is not possible always to use an oxidising mordant. When tartar, argol, oxalic acid, lactic acid, and other assistants of an organic nature are used, then a different effect is obtained, the bichromate is decomposed completely and a deposit of chromium oxide formed on the wool. This does not exert any action on the colouring matter and hence this mordant is known as the non-oxidising mordant. It may be pointed out that, when wool is mordanted with potassium or sodium bichromate and sulphuric acid (oxidizing mordant), it has a deep yellow color, while it has a green color when mordanted with bichromate or other chrome salt and the assistants enumerated above. One sign of a well-mordanted wool is when it has a good bright tone, free from yellowness.

"Of the organic assistants, tartar is undoubtedly the best in general use, and, although slow in its action, leaves a good deposit of oxide of chrome on the wool in a suitable condition to develop the best results on dyeing. Argols are only an impure tartar. They can only be used when dark shades are to be dyed. Oxalic acid does not work as well as tartar, and there is not so much chrome oxide deposited on the wool, while there is a slight tendency for a small proportion of this to be in the form of chromic acid. Of late years lactic acid and lignorosin have been added to the list of assistant mordants; both these give excellent results, they lead to a more complete and more uniform decomposition of the bichromate, and therefore the mordanting baths are exhausted more completely so that rather less bichromate is required; the shades which are obtained are in general fuller and brighter."

Knecht[19] says much the same thing. "More brilliant colours are obtained when organic acids or acid salts (for example, formic or oxalic acid or tartar) are used along with the bichromate. The latter is partly reduced, and chromic hydroxide formed on the fibre. In this case the wool has a greenish colour, like that of the chromium salts and chromium hydroxide. The quantity, however, of organic substances usually employed is not always sufficient to reduce the whole amount of bichromate that is extracted from the bath by the fibre. Up to a few years ago tartar was employed most generally as an assistant for mordanting with bichromates, three percent of bichrome and 2.5 percent of tartar, being the usual quantities or, four percent of bichrome and three percent of tartar. Sometimes the oxalic acid was used on account of its lower price, although its action as regards even mordanting and good reduction of the bichromate is inferior; for 3–4 percent of bichromate about 1–2 percent of oxalic acid was employed. During the last few years lactic acid, lactoline, and lignorosine have come very generally into use; they exert a very good reducing effect, and the mordant is satisfactorily and fairly evenly fixed. The proportions recommended are 2–3 percent of bichromate and 3–5 percent of lactic acid, with or without the gradual addition of 1–1.5 percent of sulphuric acid; or 1.5 percent of bichrome and 3 percent lactoline; or 2.7 percent bichrome, 4–5 percent lignorosine, and 1.8 percent of sulphuric acid for dark shades; and for light ones, 1.3 percent of bichrome, 2.7 percent lignorosine, and 0.8 percent sulphuric acid. Recently formic acid has been introduced by S. Kapff[20] as a very effective assistant which exhausts the chrome bath entirely, and makes it possible to mordant even the deepest shades with only 1.5–2 percent of bichrome and the same quantity of formic acid."

Matthews[21] is a good deal worried over the chemistry of the process. "Chromium hydrate is a greenish blue body, and if this substance were precipitated in the fibre by the usual methods of mordanting, the wool should have a greenish blue appearance; but as a matter of fact it has a yellow color, which is a certain indication that chromium hydrate has not been precipitated in the fibre. Indeed, it would be difficult to explain, in a chemical manner, just how chromium hydrate could be formed by boiling wool in a solution of potassium bichromate and tartar or lactic acid, and more so as it is well known that certain organic bodies such as sugar, glycerol, organic acids, etc, prevent by their presence the precipitation of chromium salts. . . . Furthermore if wool is mordanted with chrome and lactic acid, the bath at first is yellow, then green, and finally colorless, while the wool becomes

colored only slightly, in spite of the fact that all the chrome has been taken up by the fibre. If chromium hydrate were in the fibre, the color of the latter should be bluish green, and if a salt of chromium oxide as such were in the fibre, the latter would be green."

Everybody seems to be against Matthews on the question of color. Beech's statement has already been quoted. Nearly thirty years ago Liechti and Hummel[22] reported on the same subject. "Now, when wool is mordanted with three percent bichromate of potash and 2.5 percent cream of tartar, the following appearances are observed. At first the tartar merely acts as an acid and liberates chromic acid, which as usual is immediately attracted by the wool. If then the temperature is raised to about 60° C, the reductions begin, and in fact upon the wool fibre itself, which thus acquires a greenish colour; the mordant solution remains of a yellow colour, due to potassium chromate, and only towards the end of the mordanting process does it become pale greenish-yellow and show a faint turbidity and an alkaline reaction. The presence of chromic hydrate can be detected in the solution by adding clear lime water, and a relatively larger proportion of potassium chromate is also discernible therein."

Since everybody but Matthews knows that chromic acid will oxidize tartaric and lactic acids, it is difficult to see what he had in mind. It is possible that Matthews meant that chromic acid does not have much oxidizing power in such dilute solutions. Liechti and Hummel[23] worked ordinarily with ten grams of wool in 600 cc of water. If now a solution of three percent bichromate and 2.5 percent tartar, referred to wool (molecular ratio 1 : 1.3), and as dilute as is usual in mordanting (0.5 g and 0.4 g. per liter) be boiled for an hour and a half, no reduction whatever takes place. "If the solution is evaporated to dryness on the water-bath and the residue is then re-dissolved and the solution again evaporated, or if the two dry substances mixed together are moistened with a very little water and then allowed to act upon each other, being heated on a sand-bath, reduction certainly occurs; but it is for the most part incomplete. Most remarkable is the fact that the liquid, which is of a fine, dark, pure green or olive green colour according to the amount of reduction, shows a strongly alkaline reaction and deposits a dirty white powder." In the presence of the wool, however, reduction takes place readily and, for the most part, in and on the fiber. This has been shown particularly well in the case of oxalic acid. "If wool is impregnated with solutions containing oxalic acid and bichromate of potash and is steamed, then even one mol oxalic acid produces considerable reduction and with two mols it is complete. Here too, it is evident that the wool itself has assisted materially in the reduction for if a solution of one mol bichromate of potash with two mols oxalic acid is boiled, one obtained partial reduction only, namely, to chromium chromate and not to chromic oxide." "Whenever wool is mordanted with bichromate of potash with additions of oxalic and tartaric acid, the reduction with oxalic acid is invariably less than that with tartaric acid."

Liechti and Hummel[24] duplicated their experiments with oxalic acid, using tartaric acid as an assistant. "The chief difference noticed is that here total reduction, i. e., green mordanted wool is obtained with ease, and that even larger amounts of tartaric acid have comparatively less injurious effects than oxalic acid. Bichromate of potash with 1–2 mols tartaric acid gives somewhat darker colours in dyeing than when bichromate alone is employed; with increasing amounts of tartaric acid the dyed colour becomes somewhat greener and paler (quercitron bark). The mordanted fents have a dull gree colour, the intensity of which increases with the use of 1–4 mols tartaric acid. Although the waste mordant solution with bichromate of potash and four mols tartaric acid had only a pale yellowish-green colour and the mordanted wool appeared to be the best of the series, the quercitron-dyed colour appears the palest and most greenish in tint.

"If wool is padded in a solution of one mol bichromate of potash, one mol of tartaric acid and is then steamed, total reduction takes place; on washing with water an alkaline chromic oxide salt solution is obtained; with two mols tartaric acid the colour of the wool is grass-green, and the wash-water only very slightly alkaline; with three mols tartaric acid and wool showed a violet-grey colour and water extracted chromic oxide salt solution having an acid reaction.

"If a solution of bichromate of potash with the addition of only two mols tartaric acid is boiled, unlike the case with oxalic acid, reduction does occur here, although only on evaporating. With larger amounts of tartaric acid the reduction is increased correspondingly, but apparently six mols tartaric acid are required to effect complete reduction when boiling 2–3 hours."

These experiments of Liechti and Hummel furnish the explanation for the later experiments of Ganswindt.[25] He claims that ten parts of tartar are necessary to effect the complete reduction of one part of potassium bichromate. This may perfectly well be true under the conditions of his experiments for Liechti and Hummel needed six mols (four parts) when boiling two to three hours; but that does not justify Ganswindt in saying that the use of two and a half parts of tartar to three of bichromate is utterly foolish and not based on chemical knowledge. One can have complete reduction if the reduction runs to an end even on the assumption that the tartrate is oxidized only to oxalate:

$$K_2Cr_2O_7\ (294.4) + KHC_4H_4O_6(188.1) = Cr_2O_3 + K_2C_2O_4 + KHC_2O_4 + 2H_2O.$$

Nobody claims that the bath is exhausted under these circumstances. Liechti and Hummel[26] say, for instance, that "it is quite certain that wool mordanted with bichromate of potash and cream of tartar contains both chromic oxide and chromic acid, for by boiling with sodium carbonate one obtains a solution of sodium chromate and green coloured wool." The serious mistake that Ganswindt has made is in assuming that the amount of reduction would be the same with and without wool.

Liechti and Hummel made some interesting experiments on the reduction of the bichromate before the wool is added. "If wool is boiled with three percent bichromate of potash, one percent sulphuric acid, and 2.5 percent cream of tartar, the wool is decidedly better mordanted; it has a purer and darker green colour, and acquires a deeper colour in an alizarin dye-bath. If the above-mentioned liquors are previously reduced, i. e., apart from the fibre and only then employed for mordanting wool (instead of adding the several ingredients at once to the mordant-bath) one obtains, curiously enough, very poor results; the baths contain potassium chromate and a quantity of precipitated chromic hydrate, and exhibit an alkaline reaction. When the mordanted patterns are dyed with quercitron bark, the depth of the colour is less than one-third of that obtained with the fresh unreduced mordant.

"Our attention was first drawn to this point by noticing that poor shades were obtained whenever, in pursuing the ordinary course of dye trials, a student had allowed the mixed mordant in concentrated solution to stand over night or longer before use. A satisfactory, non-oxidizing, chromic oxide mordant, ready for immediate use by the dyer, cannot therefore be prepared in this manner. The unfavorable result is mainly to be attributed to the alkaline state of the solution since tolerably fair results are obtained by adding to the reduced mordant solution the requisite amount of acid, for example, sulphuric acid. This experiment indicates that wool must never be mordanted in alkaline baths, a fact afterwards substantiated invariably whenever alkaline baths were employed incidentally."

This last conclusion does not seem to me to be justified by the facts. While an alkaline solution may be bad, the real difficulty in this case was that the chromic oxide was not peptized sufficiently and consequently was not taken up satisfactorily.

Liechti and Hummel[27] have made experiments, starting with the so-called chromium chromate. "In recent years three chromium chromate mordants have been recommended for cotton and silk by von Gallois and introduced to the trade as chrome mordants, HA I, GA II, GA III, by Messrs. Meister, Lucius, and Bruning of Hoechst. It seemed desirable, therefore, to try similar compounds for wool. Experiments were made with mixtures of chrome alum and bichromate of potash.

The simplest method to obtain a chromium chromate seemed to be to follow the equation:

$$Cr_2(SO_4)_3 + 3K_2Cr_2O_7 = Cr_2(CrO_4)_3 + 3K_2SO_4.$$

On mordanting wool with the aboxe mixture, equivalent to three percent $K_2Cr_2O_7$, the bath quickly became turbid and the experiment was not continued. Another experiment in which the proportions were in accordance with equation:

$$Cr_2(SO_4)_3 + 2K_2CrO_4 = Cr_2SO_4(CrO_4)_2 + 2K_2SO_4$$

showed this mixture also to be of no use."

Experiments were made with varying amounts of different acids and the conclusion was that "the use of solutions of chromim chromates as mordants for wool seems unpromising. Useful results are obtained only when fairly large amounts of organic acid are used as well, in which case there is no advantage over bichromate of potash. It is well to note that wool mordanted in the manner described always seemed to have a pleasant soft feel.

"In a subsidiary experiment a piece of wool was padded with a solution containing one mol chrome alum, one mol $K_2Cr_2O_7$, and two mols oxalic acid, dried and steamed; it thus acquired a dull olive-grey colour, so that here too the reduction was incomplete. Total reduction occurred, however, if two mols of tartaric acid were used instead of oxalic acid, and the wool acquired a violet-greenish-grey colour rather than green, indicating that a chromic oxide salt was present in the fibre rather than chromic hydrate.

"In comparing the two methods of fixing the mordant by steaming and by boiling, it is generally found that in the former the presence of less acid was needed than in the latter, evidently because of the greater concentration of the mordant solution in the former case. If in the last-mentioned experiment the acid was omitted entirely, the fent acquired a brownish-green colour, pointing to the presence of both Cr_2O_3 and CrO_3, and there was apparently total fixation of the mordant."

Though it is outside the scope of this article, one cannot help wondering whether the violet color obtained twice by Liechti and Hummel may not be the same form of chromic oxide which gives the red color to the ruby and to the chrome pink glazes. Ganswindt[28] appears to have got something similar, using oxalic acid. "Wool was boiled for an hour and a half with three percent potassium bichromate and three percent oxalic acid. The violet and not the green modification of the chromium salts is formed under these conditions. The mordanted wool shows a characteristic dichroism. In thin layers it is green by transmitted light. In thicker layers, or by reflected light, it is violet."

Ganswindt[29] holds forth in a characteristic manner on the addition of lactic acid to bichromate. "The process came to us originally from America, where lactic acid was first prepared and used technically. The use of lactic acid as a reducing agent when mordanting with bichromate was advertised in such a typically American manner that lactic acid was not taken seriously at first. The American technical press told so many good things about the process that it seemed worth while to test it. It turned out that lactic acid was really a first-class reducing agent for bichromate, better than tartar or oxalic acid. In 1896 the firm of C. H. Boehringer and Sons began the manufacture of lactic acid technically and assigned to the author of this book [Ganswindt] the task of working out the details of its commercial application. The fundamental experiments were made with a 70 percent lactic acid and the original formula was three percent bichro-

mate of potash and two and a half percent lactic acid. When fifty percent lactic acid was put on the market later, the formula was changed to three parts bichromate to three of lactic acid. Reduction takes place much more rapidly and at a distinctly lower temperature when lactic acid is used instead of tartar or oxalic acid and more chromium is taken up by the fiber. Dreher changed the original formula to 2.75% bichromate, 2.5% lactic acid and 25% sulphuric acid; and still later to 1.5% bichromate, 3% lactic acid (50% pure), and one percent sulphuric acid. The idea evidently was that lactic acid would reduce free chromic acid more easily than a potassium salt of it. This did actually give an admirable mordant; but the addition of sulphuric acid is not absolutely necessary. The author [Ganswindt] has usually had his students work with two percent bichromate and three percent lactic acid, which forces the whole of the chromium on the fiber in a relatively short time. One can also use 1.5–3.0 parts of bichromate of potash or soda, 3–5 parts of fifty percent lactic acid and three parts of thirty percent acetic acid (6° Baume). Dreher assumes that the chemical reaction in the mordant bath is the oxidation of lactic acid by chromic acid to acetic and carbonic acids; but, in that case, the solution should become violet through formation of chromic acetate. This does not happen. The originally yellow color of the solution disappears in about ten minutes but the solution does not become either green or violet, which shows that some other chemical reaction takes place. Wool is almost colorless after mordanting with bichromate and lactic acid and shows no sign of yellow, thus differing from wool mordanted with tartar or oxalic acid. When the mordanting is done properly, the bath is almost colorless and chromium cannot be detected in it. The chief advantage of the lactic acid mordant is that it forces the chromium quantitatively on the fiber." Somebody will of course have to find out why chromic oxide does not color wool under these conditions; but, beyond that, this paragraph is interesting chiefly for its psychological bearing. Lactolin is a mixture in equivalent parts of potassium lactate and lactic acid, thus being superficially analogous to acid potassium tartrate.

A German patent[30] claims that formic acid is the cheapest and best organic acid to use because it requires no sulphuric acid, reduces the chromate so slowly that there is no danger of uneven mordanting, and yet fixes the chromium quantitatively on the fiber. This optimistic view is not confirmed entirely by Whittaker[31] who recommends using 1–2 percent bichromate and an equal amount of 85 percent formic acid. "Since the reduction of the bichrome with this assistant takes place rapidly, uneven dyeings result, unless the mordanting is carried out carefully. The wool should therefore be entered at 140° F (60° C), and the wool worked whilst the bath is brought gradually to the boil, then boiling continued —1.5 hours. The bath will be exhausted of chrome.

"When bichrome and formic acid are used, it will be noticed that much less bichrome is used, the whole being precipitated on the fibre. The bath is so well exhausted of chrome that the same liquor may be used for dyeing as was used for mordanting. In no case must the bichromate and assistant be dissolved together in a small quantity of water. The assistant should be added to the bath just before the wool is going to be entered."

Wool and Chromic Salts

Liechti and Suida[32] have studied the visible decomposition of various chromium salts on boiling or dilution, starting with chrome alum and with the sulphates, sulphocyanates, and acetates of chromium. As was to be expected, the hydrolysis is greater the more basic the solutions. Only those basic chromium acetates which contain sulphates are hydrolyzed visibly by dilution alone. This is the result of the coagulating action of the sulphate ion. Freshly prepared chromium acetates resist the action of precipitating agents more strongly than do solutions which have aged. This merely means that there is a time factor in the hydrolysis.

Liechti and Hummel[33] have studied the behavior of chrome alum and other chromium salts with wool. "Among the various chromic oxide salts the first to be considered is chrome alum, $Cr_2(SO_4)_3.K_2SO_4.24H_2O$. Although seldom or never used by woolen dyers, this salt has long been employed by calico printers, who already, more than forty years ago, recognized the necessity of applying chromium in some other form than that of potassium bichromate, wherever, indeed, the oxidising property of the latter was found to be injurious, or was not beneficial. At one time a very expensive chemical, and consequently excluded from use in practice, it has now for many years been the custom of the calico printer's colourist to prepare chrome alum by reducing potassium bichromate in the presence of sulphuric acid, with glucose, starch, glycerin, etc.

"As early as 1851 C. Koechlin made experiments with chrome alum, not only as a mordant for cotton, but also for wool. His results appear to have been very unsatisfactory, for he says that chrome alum is the least satisfactory of the salts from which to obtain the oxide; the nitrate gives better results. For wool (probably woolen printing is meant) he recommends the use of chromium acetate with the addition of one equivalent of oxalic acid; he finds the oxalate and the nitrate to be the best mordants for wool.

"Gehe recommends chrome alum in place of bichromate, because, he says it is cheap, does not make the wool hard and brittle, and it gives level colours which do not rub off so much. Peissert also prefers chrome alum to bichromate of potash because he finds it to yield more level colours, and he recommends it to be used with the addition of a little sulphuric acid. Joclet, too, recommends chrome alum for wool, and states that the fibre absorbs the salt as such, not as a basic salt or as a hydrate. He considers that the salt is decomposed in the dye bath only, for although the chrome alum is not washed out by

cold water it can be removed by hot water. The addition of cream of tartar he deems to be unnecessary, although it is absorbed by wool to the extent of one-fourth the weight of the chrome alum employed. Curiously enough Joclet says that chrome colours are not very fast to light. Ganswindt and Kertesz recommend the use of cream of tartar as an assistant. Depierre considers all chromic oxide salts to be inferior mordants to bichromate of potash. According to Herzfeld green solutions of chrome alum give up more oxide to the fibre than violet solutions, and he finds it desirable to employ large amounts of cream of tartar. Kay and Bastow find, on comparing bichromate of potash with chrome alum as mordants, using equivalent amounts, that the latter gives up to the fibre twice as much Cr_2O_3 as the former; they also observe that by employing larger amounts of chrome alum, e. g.(twenty percent instead of ten percent, less chromium is fixed, e. g., 53.07 percent instead of 63.87 percent; and with the use of three percent of tartaric acid the amount fixed is reduced as low as 30.7 percent. Koepp enumerates the following advantages in connection with the use of chromic oxide mordants (referring no doubt to the use of chromium fluoride): the wool preserves a soft handle and is readily wetted out and there is no fear of over-chroming. Knecht, Rawson and Loewenthal consider that part of the chromium sulphate is probably simply absorbed by the wool fibre and is not fixed in a permanent manner, and thus account for the poor results obtained in dyeing. Cochenhausen recommends the use of four mols cream of tartar; Witt also recommends tartar, but does not find chrome alum to be an advantageous mordant. Previous experiments in the Yorkshire College dyehouse have shown that cream of tartar, tartaric and oxalic acids are all useful assistants with chrome alum."

(*To be concluded.*)

References Cited in "Mordants"—III

[1] Jour. Soc. Chem. Ind., 12, 241 (1893)
[2] "Theorie und Praxis der modernen Färberei," II, 69 (1903).
[3] "Application of Dyestuffs," 344 (1920).
[4] Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 255 (1910).
[5] "Application of Dyestuffs," 344 (1920).
[6] Jour. Soc. Chem. Ind., 12, 244 (1893); Ganswindt: 14, 654 (1895).
[7] Ibid., 6, 131 (1887).
[8] Liechti and Hummel: Jour. Soc. Chem. Ind., 12, 244 (1893).
[9] Schwalbe: Zeit. Kolloidchemie, 5, 130 (1909).
[10] Jour. Soc. Chem. Ind., 12, 242 (1893).
[11] "Application of Dyestuffs," 477 (1920)
[12] Jour. Soc. Chem. Ind., 12, 244, 246 (1893).
[13] Liechti and Hummel: Jour. Soc. Chem. Ind., 12, 242, 246 (1893)
[14] Jour. Soc. Chem. Ind., 14, 452 (1895).
[15] Jour. Soc. Chem. Ind., 14, 454 (1895)
[16] Ibid., 14, 453 (1895).
[17] Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 256 (1910).
[18] Beech: "The Principles and Practice of Wool Dyeing," 116 (1902).
[19] Knecht, Rawson and Loewenthal: "A Manual of Dyeing," 256 (1910).
[20] Jour. Soc. Dyers and Colourists, 1905, 75.
[21] "Applications of Dyestuffs," 502 (1920).
[22] Jour. Soc. Chem. Ind., 12, 234 (1893).
[23] Jour. Soc. Chem. Ind., 12, 242, 334 (1893).
[24] Jour. Soc. Chem. Ind., 12, 333 (1893).
[25] Jour. Soc. Dyers and Colourists, 1895, 152; "Theorie und Praxis der modernen Färberei," II, 73 (1903).
[26] Jour. Soc. Chem. Ind., 12, 335 (1895).
[27] Jour. Soc. Chem. Ind., 13, 363 (1894).
[28] "Theorie und Praxis der modernen Färberei," II, 75 (1903).
[29] "Theorie und Praxis der modernen Färberei," II, 76 (1903).
[30] Zeit. Farben-Industrie, 4, 159 (1905).
[31] "Dyeing with Coal Tar Dyestuffs," 52 (1919).
[32] Jour. Soc. Chem. Ind., 4, 586 (1885)
[33] Ibid., 13, 222, 256 (1894)

COLORING POISONS TO AVOID ACCIDENTS

Experiments are being made by the Pharmaceutical Society of Great Britain to test the feasibility of the proposal made by several High Court judges that poisons should be given distinctive colors. The practicability of the proposal, from the point of view of color makers, was discussed in an interview by Dr. A. T. de Mouilpied, of the British Dyestuffs Corporation's headquarters staff. "Already," he pointed out, "there is a government regulation that methylated spirit should be colored with an aniline dye. The effect has been to make the drinking of methylated spirit more difficult. Nowadays a person buying methylated spirit does not try it or smell it; he merely looks at it. So, in time, it would be with arsenic and strychnine and cyanides, had each of them its particular tinge." The coloring of arsenic, he suggested, would not only prevent accidents but would assist in the detection of crime.

COLORIMETRIC DETERMINATION OF HYDROGEN PEROXIDE

Thirty cubic mentimeters of water, 10 cubic centimeters of 5 per cent solution of citric acid, and one cubic centimeter of dilute solution of hydrogen peroxide are mixed, and one cubic centimeter of 10 per cent solution of ammonium molybdate is slowly added. A yellow color develops. This reaction may be used for the colorimetric determination of hydrogen peroxide. The yellow solution is diluted to a volume of fifty cubic centimeters and is compared in a Duboscq colorimeter with a standard solution of potassium chromate. This solution contains 0.4 gram of potassium chromate per liter, and in standardized against the color yielded by hydrogen peroxide of known concentration.

At the request of the Industrial Division of the American Red Cross, a committee of men prominent in the silk trade was formed under the chairmanship of George A. Post, of the Post & Sheldon Corporation, to promote the work of the annual Red Cross roll call among the men of the silk industry. Besides Mr. Post, the committee is composed of Frank G. Barry, John D. Dunlop, James A. Goldsmith, E. Irving Hanson and Albert Tilt.

Dyeing Wool-Silk Materials the Same Shade

Suitable Acid Dyes—Securing Results by Means of Temperature Control in Certain Cases—Begin Dyeing Cold—Selection of Dyes for Use at Determined Temperatures—Basic Dyes—Points to Remember

By GEORGE EMMONS

IT will often be the case that the dyer is called upon to dye mixture of wool and silk yarns one and the same shade. For this purpose one may use dyes belonging to any one of the following classes:

Acid dyes.
Basic dyes.
Direct dyes.

It is not suggested that any and every dye belonging to each and every one of these classes is suitable for the practical dyeing of a mixed wool and silk fabric a uniform shade.

Let us consider the acid dyes first. Experience has shown that there are a considerable number of dyestuffs of this class that lend themselves to the dyeing of a uniform shade on the two fibers. One selects a dye from those enumerated and dissolves the proper amount in a small amount of water. This solution is added to the plain water of the dye bath. Then one adds from 5 to 10 per cent of Glauber salt and from 1 to 3 per cent of sulphuric acid. Instead of the acid, one may use from 5 to 10 per cent of sodium bisulphate. This bath is then heated up to about 160 deg. Fahr. (71 deg. Cent.). The goods are then entered and the bath brought gradually up to the boiling point. There may be difficulty in getting the silk to color as well as the wool. In this case, one permits the dye bath to cool down. A properly dissolved quantity of a basic dye is then added. The goods are now run through the dye bath for, say, fifteen minutes, after which they are well rinsed.

Suitable Acid Dyes

It is to be understood that the foregoing directions are general ones. The various dyestuffs of the acid class may require variations in order to get the best results. Acid dyes suited to the simultaneous dyeing of wool and silk are enumerated in the following list:

Acid Dyes

Acid Rhodamine R.
Acid Rosamine.
Alkali Blue.
Alkali Violet LR.
Anthracene Red.
Anthracite Black B, R.
Azo Acid Yellow.
Azo Yellow O.
Bordeaux extra.
China Yellow B.
Cloth Red 3GA.
Curcumeine.
Cyanole Fast Green G
Fast Blue B, R.
Fast Light Green.
Fast Red.
Fast Scarlet.
Formyl Violet S4B.
Gloria Black B.
Guinea Green B, G.
Indian Yellow.
Light Blue for Silk.
Mandarine G
Martine Yellow.
Naphthylamine Black 4B.
Neutral Wool Black B, G, 4B.
Orange II.
Patent Blue AV.
Phloxine.
Ponceau 3RB.
Rhodamine B.
Silk Black 4BF.
Silk Red N, G, R.
Wool Black GR.

These are not all the acid dyes that are adapted to the purpose of dyeing the two fibers in a single bath; but they are sufficient in number to illustrate the point. If this list be compared with the list, given in a previous article, of acid dyes suited to dye wool at the boiling point and to leave the silk but little affected, one may find one or more duplicates. Thus, Orange II is in both lists. How is this? In one list, it is a dye for wool but not for silk; in the present list, it is given as a dye adapted to color both fibers in one bath.

The explanation turns on the matter of temperature. Acid dyestuffs have, in general, a strong affinity for wool at a high temperature but markedly less, or none, for silk. At a low temperature, there will be reversal of this situation, as between wool and silk.

Results of Temperature Control

This leads to the idea that if a certain acid dye, X for example, has a strong affinity for wool in a high temperature bath and little or no affinity for the same fiber at a low temperature, and has the opposite affinities for silk, then perhaps there is an intermediate temperature at which X will have the same affinity for both the wool and the silk. This idea seems to be justified, at least in numerous acid dyes. However, we are not to get the impression that this intermediate temperature is the same, or even nearly the same, for the several dyes. Thus, Whittaker has cited three to show the wide limits within which the average lies. The following dyes have set after them their respective average temperature, at which it is advantageous to use them for simultaneously coloring wool and silk:

Orange IV	212 deg. Fahr.
Quinoline Yellow	140 deg. Fahr.
Fast Red	100 deg. Fahr.

We have here a very wide range running from 100 to 212 deg. Unfortunately, nobody seems to have been philanthropic enough toward the dye business to work out and publish the average temperature for all the suitable acid dyes. And so I am unable to give for all the dyes in the list the proper dyeing temperature. Besides, if a complete set of temperatures were given, they would apply to certain conditions. That is to say, temperature is not the only governing factor. The structure of the fabric plays its part, and this tends to modify the temperature. For example, "a hard, twisted crossbred yarn will naturally be dyed a heavier shade than a loosely spun Botany yarn at the same temperature."

In consequence of the foregoing considerations, a proper plan for the dyer to follow is to begin the dyeing cold and work up gradually from this point to that where the coloring effect on both fibers is the same. He may find during this process that the wool is lighter than the silk. This means, generally, that the temperature is still too low, and that it should be raised in order to give the wool a better chance. On the other hand, the silk may at some stage appear to be getting too little color from the bath. This is usually to be taken to mean that the temperature is too high, and that it should be lowered in order to give the silk a better opportunity. These are the general principles, and, applied by a man of skill and intelligence, they should lead to good results.

Selection of Dyes for Use at Determined Temperatures

A little reflection will perhaps prepare the reader to understand that if a combination of dyes is used, a good deal of trouble may ensue, because of the fact that dyes have their individual average temperatures. Unless the dyes are selected not merely to get the proper shade but also as to have approximately the same average temperature, one is to expect a good deal of trouble. It so happens that there are many direct dyes whose average temperatures lie in the range 90 to 100 deg. Cent. (194 to 212 deg. Fahr.). This is a short range, being only ten Centigrade or eighteen Fahrenheit degrees. "These are excellently adapted for giving solid shades with mixtures of three dyestuffs: they are particularly suitable for production of browns, greens, olives, etc., while the phoncyanine class of dyes are excellently adapted for blue and navy shades dyed in a neutral bath."

Basic Dyes

It will now be seen, perhaps, that the general directions for dyeing simultaneously the two fibers in one acid bath with the aid of acid dyes are to be used with caution. In particular, the temperature there suggested—212 deg. Fahr.—may in quite a number of cases be entirely too high.

In using basic dyes to produce a single solid shade on a fabric made of woolen and silk yarns, it is desirable, in general, to use a neutral bath. The dyeing may be done for one hour at the boiling point. If an acid bath be employed, the generality of basic dyes may be expected to dye the silk a heavier shade. There are several exceptions perhaps to this statement. Magenta and Chrysoidine have been cited as such.

Apparently, this matter of the use of basic dyes for the simultaneous production of a single shade on both fibers has not been investigated to the same extent as has the matter of using acid dyes for this purpose. It is quite possible that temperature or some other factor may play a large part and that something analogous to the "average temperature" may be required in order to get the best results. A full investigation may be made in the future and the results published. In the meantime, the dyer may use the general directions in an experimental way, modifying them now in one particular, now in another, in the effort to get the very best results.

Magenta has been mentioned as an exception. This dye is a basic color that may be dyed on wool and on silk in an acidulated bath. The shade produced on wool is not fast against light or milling. With wool alone, a boiling bath is probably employed. On silk, magenta may be dyed from an acid bath. First, the silk is washed in order to get rid of any soap. It may then be dyed in a warm bath containing acetic or tartaric acid. More or less experimentation is to be used prior to actual dyeing of any considerable importance. Probably a considerable jockeying of the temperature will be required for the purpose of determining a useful average suited equally well to wool and silk.

Chrysoidine was also mentioned as an exception. This dyestuffs is applicable both to wool and silk; but in neither case does it seem ever to have become very popular.

The remarks made as to Magenta and Chrysoidine are to be taken for what they may be found to be worth. If the reader does not want to do any experimenting, he can disregard the statements and suggestions made.

Where the basic dyestuff is found to color the silk fiber more easily than the wool, it may at times prove suitable in the production of two color effects. Or, it may perhaps be used in shading the silk, since it colors it more readily.

In concluding this article on the dyeing of wool-silk fabric a single shade, some points may well be emphasized.

Points to Remember

While the yarns in such goods as poplin, half-size cashmere and bombazine, crepe de Chine, and the like are not composite, and two distinct yarns are employed, nevertheless the fabric may require treatment in advance of the dyeing. That is, the silk may not be completely rid of its glue. Under such conditions, the goods are to be given a treatment in a hot solution of neutral soap.

The bath is not to be allowed to come to the boil. In fact, it will be well to keep the temperature under 190

deg. Fahr. (88 deg. Cent.). The reason here is that we must preserve the wool while getting the glue out of the silk.

Further, the bath should contain no alkaline substances for the same reason.

To the dyestuffs already listed as more or less adapted to color a wool-silk fabric a single shade may be added the following:

Azo dyes. There are understood to give good results—better perhaps than the basic colors.

Alizarine is said to dye both fibers equally well.

Alkali Blue has been recommended for blues; Naphthol Black and Naphthylamine Black for navy blues and blacks; Naphthol Green for greens, and Acid Magenta for reds.

Certain direct dyes may be used readily on wool-silk fabrics. Examples are: Titan Yellow, Chrysophenine, Brilliant Congo, Delta-purpurine and Diamine Brown.—Silk.

Mechanical Appliances for Pumping Chemical Solutions

Part III

Gear Pumps for Viscous Liquids, Not Acid—The Centrifugal Acid Pump—Its Advantages and Limitations—Vertical and Horizontal Types—Use in Manufacture of Dyestuffs and Intermediates—Hints on the Selection of a Chemical Pump

By A. K. FISCHER

President, Schutte & Koerting Company, Philadelphia, Pa.

E1—Gear Pumps

ALTHOUGH the gear pump cannot properly be classified as a chemical pumping appliance, inasmuch as it cannot be made of such acid-resisting materials as lead or stoneware, nevertheless it should be mentioned in this article, as it is extensively used in the chemical and allied industries for pumping viscous liquids, such as crude oil, soda ash, coal-tar oil, linseed oil, sizing, soap, molasses, syrup, caustic soda, turpentine, etc.

A type of gear pump that excels because of its simplicity and perfect balance of the two rotors is shown in *Fig.* 44. The driven gear has two rows of holes that are drilled at the roots of teeth 180 deg. apart and that allow oil to enter slots for lubricating the bearing surfaces and for admitting oil under pressure to the center of the driven gear, thus equalizing external and internal pressures and reducing wear to a minimum.

Table XI shows the capacities and pressures against which these pumps ordinarily operate. They can be driven either by a belt or a motor with suitable reduction gears.

E2—Centrifugal Acid Pump

Centrifugal acid pumps are well adapted for handling large quantities of acid—for example, quantities exceeding 50 gallons per minute—but are complicated and inefficient for small capacities. They are either of the horizontal or vertical type.

The horizontal pump requires a stuffing box that is difficult to keep tight against the destructive action of the acid. For this reason the vertical pump has been developed.

The vertical pump is either submerged entirely in the liquid, as shown in *Fig.* 45, or arranged outside of the tank containing the acid (see *Fig.* 46). The pump is always located below the low level of the liquid, and the driving mechanism above the high level of the liquid. Under these conditions stuffing boxes for rotary parts are eliminated. Vertical centrifugal pumps do not require any priming and should be used wherever possible instead of the horizontal pump.

A well-constructed lead centrifugal pump of the vertical type is shown in *Fig.* 47. For this type of pump, motor drive is the most suitable.

The liquid enters the center suction inlet and passes into the impeller, whereupon it is directed by the vanes to the periphery of the impeller and discharged at the desired velocity. The velocity of the liquid, which is highest at the periphery, is gradually reduced in the volute chamber in such a manner as to convert the velocity head of the liquid into static pressure with a minimum loss of friction.

The casing of the typical pump shown in *Fig.* 47 is of the volute design and is made of lead, bronze, Monel, regulus metal, or other acid-resisting material, in accordance with individual requirements. The clearance between the casing and impeller should be as small as practical in order to minimize slippage, and at the same time to eliminate any excessive wear that may occasionally be brought about by small par-

TABLE XI

Capacity of Gear Pump, Gallons Per Minute

R.P.M.	Size of Pump 4	4a	5	6	7	7a	8	9	10	10a
100	..	..	7.5	12.5	17	21	26	32	40	47.5
150	5.5	7.5	11	19	25	31	39	48	60	72
200	7.5	10	15	25	34	42	52	64	80	95
250	9	13	19	31	43	53	65	80	100	118
300	11	15	22.5	37.5	51	63	78	96	120	141
350	13	18	26	44	60	73	91	112	..	..
400	15	20	30	50	68	84	..	..	..	..
450	17	23	34	56	77	..	..	..	..	..
500	18.5	26	37	..	..	..	..	..	..	..
550	20	28	..	..	..	..	..	..	..	..
600	22	31	..	..	..	..	..	..	..	..

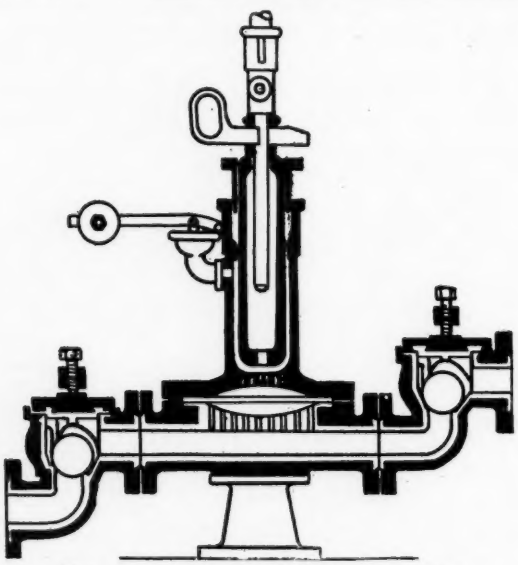


FIG. 43—*A Typical Diaphragm Pump*

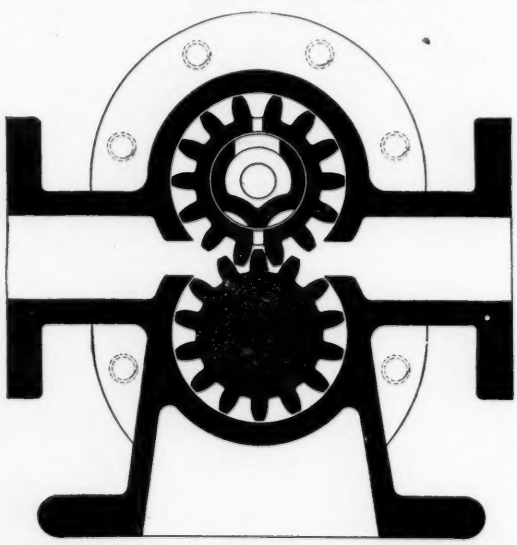


FIG. 44—*A Typical Gear Pump for Handling Viscous Liquids*

ticles of gritty substances lodged or ground in between the parts.

The shaft of the pump shown is made of steel and is covered with a sleeve made of acid-resisting material. The possibility of the shaft running out of true after being put into service is prevented by the design and arrangement of the pump bearings.

Centrifugal pumps insure steady and continuous operation. They involve minimum outlay for maintenance, upkeep and repairs, and can be built of materials suitable for handling any chemical solutions.

The capacity of the centrifugal pump ranges generally between 50 and 250 gallons per minute, and standard sizes ranging from 1½ to 4 inches in diameter meet almost any requirements.

Power consumption is small and rate of discharge can be closely regulated by changing the speed of the pump or by throttling the discharge. Even if the discharge is closed, there will be no injurious consequences because of high pressure. Little attendance is necessary.

The centrifugal pump is widely employed in the manufacture of sulphuric acid, both for elevating the acid to the top of the towers and also for transferring it from place to place in the plant. Iron pumps are suitable where very strong acid is to be handled, both in contact process acid plants and in some instances in chamber plants. Lead pumps are generally used for pumping dilute acids.

In the manufacture of alkalies, such as soda ash, lye, caustic soda, bicarbonate of soda, etc., brine is ordinarily pumped from wells into concentrators, in which it is brought to the proper density for subsequent treatment. The concentrated solution is then transferred into large cast-iron cylinders or towers known as carbonating towers. The centrifugal pump effectively resists the action of alkaline liquors and is for this reason well adapted for this type of plant.

In the manufacture of colors, dyestuffs, intermediates, pigments and similar products, centrifugal pumps are employed for transferring the various solutions from one vat to another; in by-product recovery coke oven plants,

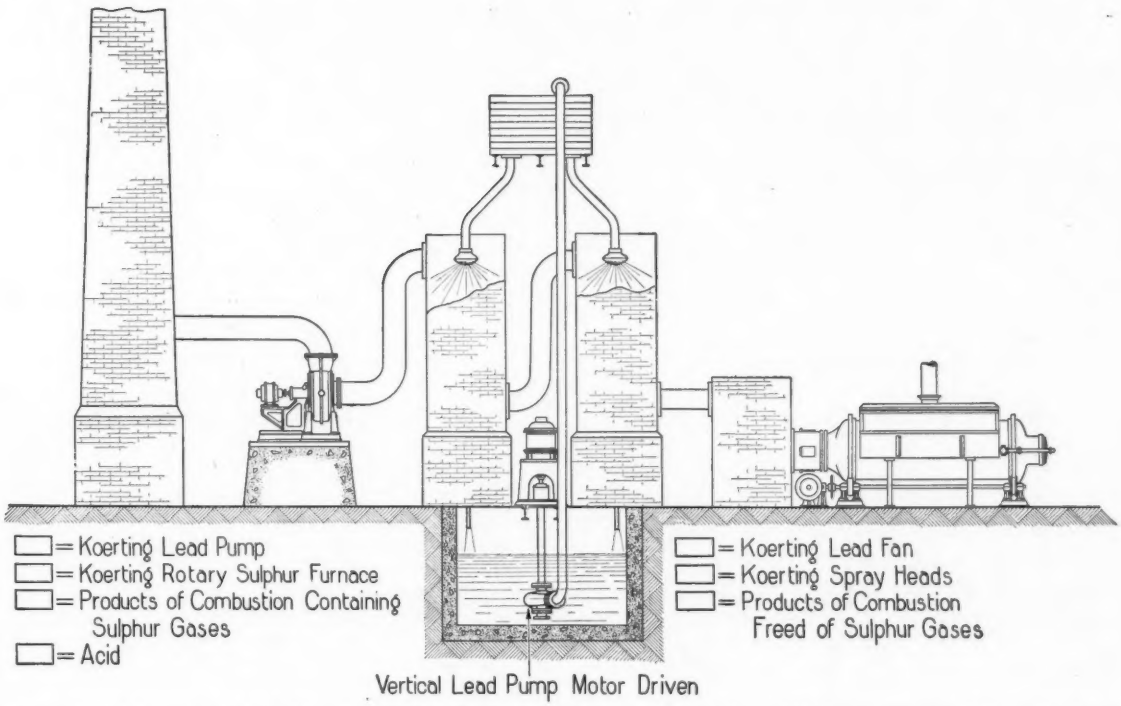

= Koerting Lead Pump
= Koerting Rotary Sulphur Furnace
= Products of Combustion Containing Sulphur Gases
= Acid
= Koerting Lead Fan
= Koerting Spray Heads
= Products of Combustion Freed of Sulphur Gases
Vertical Lead Pump Motor Driven

FIG. 45—*A Vertical Lead Pump Completely Immersed in Acid. Here sulphur gases are drawn from a rotary sulphur furnace, passed through towers wherein the gases are acted upon by water sprays, and finally discharged into a stack by means of a lead fan. The lead pump lifts the acid formed to the tank above the towers.*

for pumping the aniline oils and other liquids; in refining naphthalene for handling the acids and alkalies involved; in the manufacture of phenol for pumping acids; etc.

In explosive plants, raw materials, such as nitric and sulphuric acids, glycerine, phenol, tuluol, etc., are used. The centrifugal pump resists the destructive action of these liquids—hence its importance for this work cannot be overemphasized.

The cast-iron pipe is well adapted for handling large amounts of caustic lye that are required for treating raw oils in cottonseed and other vegetable oil refineries. In paper and pulp plants it can be installed for pumping bleaching liquor from place to place, for removing the lime from the tanks, for pumping acid liquor to the top of digesters, and for moving the watered pulp.

In metallurgical plants, lead-lined centrifugal pumps can be installed for a great variety of purposes. They are, for example, adapted for handling cyanide and other solutions used for leaching in recovery plants, and in general for pumping acids, alkalies, flotation oils, etc.

In petroleum refineries, the lead-lined centrifugal pump is employed for handling crude oil, light distillates, naphthalene, paraffin distillates, caustic lye, sulphuric acid, etc.; and in the manufacture of candles, etc., for pumping glycerine, liquid soap, lye, oils, waste liquors, etc.

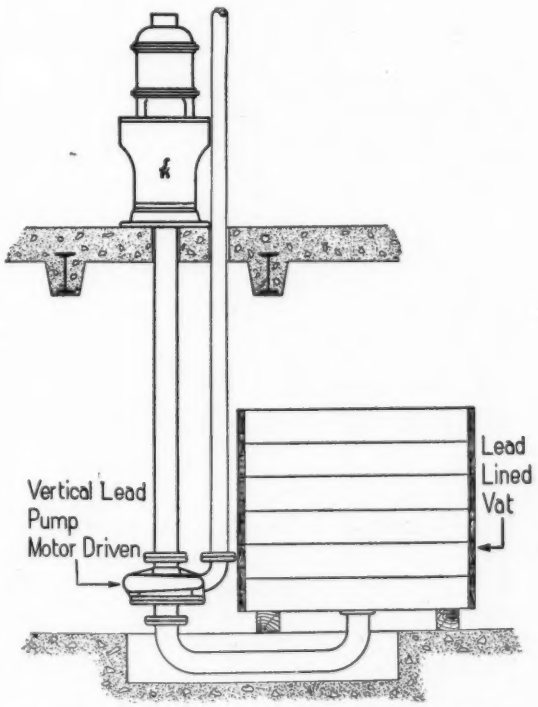


FIG. 46—*A Vertical Lead Pump Installed Outside of the Acid Tank*

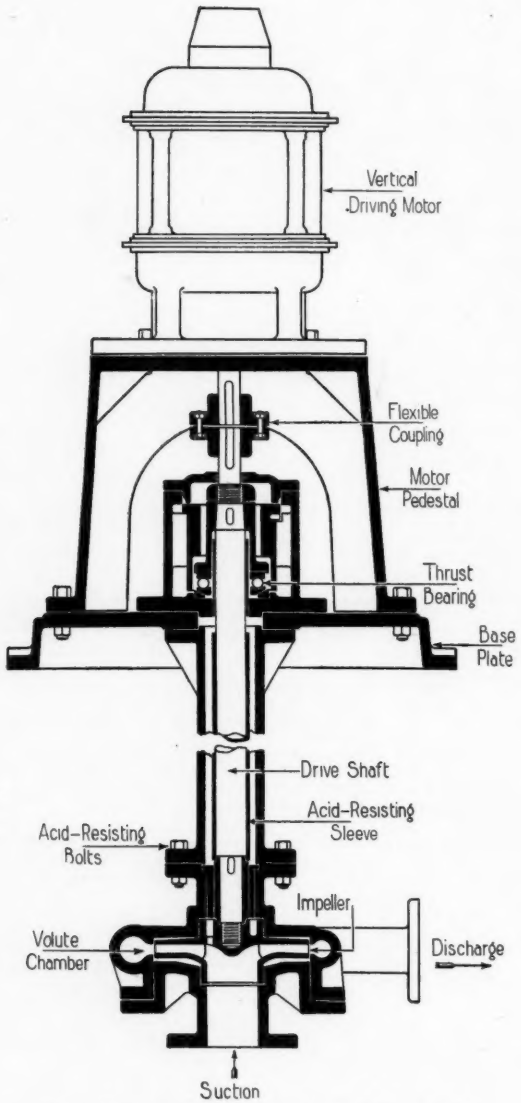


FIG. 47—*A Typical Vertical Lead Pump*

HINTS ON THE SELECTION OF A CHEMICAL PUMP

From the preceding discussion it is seen that a variety of pumps are available for handling chemical solutions. The choice among the several devices depends primarily on the actual conditions under which the pump is to operate.

If live steam is available for pumping purposes, the *Syphon* (A1) should first be considered, particularly if the liquid is to be heated or if the space for the pump is limited. On the other hand, if the chemical solution must not be diluted or heated the use of a steam jet jump is precluded.

An *Air Jet Lift* (A2) necessitates an adequate supply of compressed air and the necessary head room in order to secure the submergence required for pumping the liquid to the desired elevation. To provide the proper submergence may in turn necessitate excavation work, which in some plants is prohibitive because of the cost involved.

The *Vacuum Lift* (B) is well adapted for handling small capacities; as, for example, in emptying acid drums and for facilitating the distribution of acids on a small scale.

The *Blowcase* (C) is useful in plants where intermittent pumping is satisfactory, where liquor slowly accumulates in tanks and where the liquid is stored at the same time. However, the liquid must be one that is not impaired by contact with the air.

Diaphragm Pumps (D) should be installed where only small quantities of liquid are to be moved and where neither syphons nor air jet lifts can be used.

Gear Pumps (E1) are recommended for pumping viscous liquids in limited quantities.

Centrifugal Pumps (E2) made of chemical resisting materials require a driving motor or pulley drive. Sometimes turbine drive is available. Centrifugal pumps are recommended for capacities exceeding 50 gallons per minute; for small capacities they are inferior to the other methods of pumping chemicals.

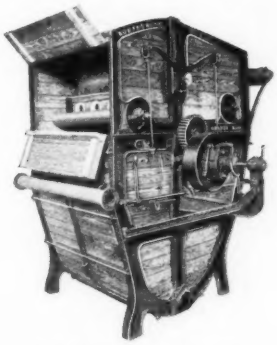
No general rules can be given. Each installation involves a number of factors involving nature of process, locality, kind of power available, simplicity, etc. The best procedure to follow is to communicate with those reliable manufacturers who have had extended experience in pumping chemical solutions under all sorts of conditions and to take advantage of their recommendations.

[THE END.]

CHEMIST'S COMMENT SAVED $30,000

Some years ago engineers at a cotton textile plant introduced an air conveying system so that prepared fiber might be quickly and cheaply transported from one part of the immense plant to another. The system was successful until cold weather came. Then the moisture in the conveying air froze in the pipe between the buildings. As the moisture froze, the fibers became attached and soon stopped the entire system. After surveying the situation the engineers concluded that the conveyor must be surrounded with steam pipes to prevent freezing. The cost was estimated at $30,000. The report was made to the president in the presence of the chemist, who required no research to understand the factors of the problem. He recommended that the fibers be conveyed in cold air drawn in from outside the building and therefore of the same relative humidity as the air around the conveyor. Although the engineers predicted it would not work, this method was tried and succeeded. The $30,000 was saved through the observation of a chemist.—Jnl. Ind. Eng. Chem.

STANDARDIZE
on
Rodney Hunt Washers



(Ask for Booklet 221)

Scouring and Rinsing

Woolens, Worsteds, Cottons, Knit Goods

Rodney Hunt Machine Co.
40 Mill Street **Orange, Mass.**

ATLANTIC PATENT BLACK

THE UNRIVALED SULPHUR BLACK that "STAYS BLACK"

SOLUBLE FAST BLOOMY BRILLIANT

An intense fast Black, possessing the greatest solubility superior and lasting bloom and brilliancy and thorough penetration

ECONOMY
The low percentage required to produce a deep black substantiates the claim for economy of use

UNIFORMITY
Uniformity of Atlantic Products is best exemplified by repeat orders which specify "SAME AS LAST SHIPPED"

ATLANTIC YELLOWS
ATLANTIC BLUES
ATLANTIC BROWNS
ATLANTIC MAROONS
ATLANTIC GREENS

ATLANTIC DYESTUFF COMPANY
Portsmouth N.H.
New York Charlotte Chicago Philadelphia Providence

Latest 1914 Berlin Edition of

"FARBSTOFFTABELLEN"

By Dr. Gustav Schultz

Containing over 1000 dyestuff formulæ reprinted and exactly reproduced by photographic process on fine white paper, and substantially bound in heavy black cloth and leather.

Can now be had from us at $10 per volume.

HOWES PUBLISHING COMPANY
4109 Woolworth Building, New York

1816 CHEMICALS *1922*

"Over a Century of Service and Progress"

BLEACHING POWDER

FINISHING MATERIALS

FORMIC ACID

COLORS

GUMS and WAXES

DYESTUFFS **CAUSTIC SODA**

INNIS, SPEIDEN & CO.

Manufacturers, Importers, Exporters of Industrial Chemicals

46 Cliff Street **New York**

BRANCHES:

Chicago Philadelphia Boston Cleveland
Gloversville, N. Y.

Consult Us About Your Dyeing Problems

The services and advice of an expert chemist and a well equipped laboratory are at your disposal without cost, except when special research or experimentation is necessary, when the charges will be of a minimum nature.

American Dyestuff Reporter

Woolworth Bldg. **New York City**

TECHNICAL BOOKS

If you are in the market for books on technical subjects — dyeing, finishing, bleaching, etc. — communicate with us and it is probable that we can supply your needs. We shall at all times be glad to submit lists of books covering any special lines.

We call particular attention to

A TEXTBOOK OF DYE CHEMISTRY

By G. VON GEORGIEVICS

This is a new edition of a former volume by the same author, entitled "Chemistry of Dyestuffs," and has been thoroughly revised and brought down to date by Dr. Eugene Grandmougin—translated by Frederick A. Mason. The new edition describes minutely the chemical properties of all dyestuffs, including the natural colors, and contains particularly a new chapter on the Vat Colors

PRICE $12.50

DYERS' MATERIALS

By PAUL HEERMANN

An introduction to the examination, valuation and application of the most important substances used in dyeing, printing, bleaching and finishing. Translated by Arthur C. Wright. Second edition, revised and enlarged by H. B. Stocks. **PRICE $3.00**

HOWES PUBLISHING CO.

4109 Woolworth Building **NEW YORK CITY**

ANSWER "PRESENT"

WHEN YOUR

American Red Cross

STARTS THE

ANNUAL ROLL CALL

Armistice Day (Nov. 11)

TO

Thanksgiving Day (Nov. 30)

YOU ARE NEEDED

In carrying out the vast peace-time obligations of your Red Cross, which steadily met the stupendous tests of the World War. The work for ex-service men and their families, and the men of the Army and Navy and their families; the calls for emergency service in fire, famine and pestilence; in fighting the battle for better health conditions for the people in all sections of the United States, deserve both your support and encouragement.

So Answer
"PRESENT"

At the Annual Roll Call and gladly pay your Dollar Membership Fee to Your
RED CROSS

THE NEWPORT COLORS

Vat Dyes

THE SUN

is the greatest chemist in all the universe, and just as eons ago it instilled into vegetation the elements we now withdraw for the production of color from coal, so is it endowed with the power of destroying these selfsame colors. To the ingenuity of man falls the task of combating this, and as a result of the endeavors of the chemist the famous series known as the

NEWPORT ANTHRENES

has been developed.

Of these the following types are now on the market:

Newport Anthrene Blue RS	Newport Anthrene Yellow G
Newport Anthrene Blue GC	Newport Anthrene Brown BB
Newport Anthrene Blue GCD	Newport Anthrene Green B
Newport Anthrene Blue BSP	Newport Anthrene Jade Green
Newport Anthrene Blue BCS	Newport Anthrene Black B
Newport Anthrene Yellow R	Newport Anthrene Dark Blue BO

NEWPORT
REG U.S. PAT OFF
"COAL TO DYESTUFF"

NEWPORT CHEMICAL WORKS, Inc.

PASSAIC, NEW JERSEY

Branch Sales Offices:

BOSTON, MASS PHILADELPHIA, PA.
PROVIDENCE, R. I. GREENSBORO, N. C. CHICAGO, ILL.